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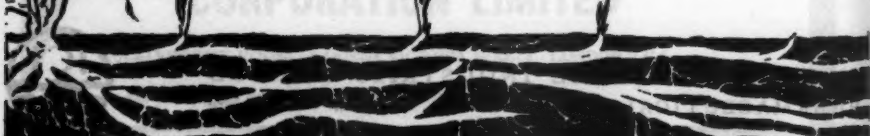

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(see *Wattle Hurdles* on p. 262)

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Farm Milling and Mixing Poultry Rations

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The following article, which is based on a talk which Dr. Eden gave in Dorset earlier this year, advances the view that making up nutritionally adequate rations is a practicable proposition for the farmer who wishes to home-mix his own foods.

SUCCESSFUL poultry-keeping nowadays demands the highest standards of efficiency in stock selection and management, housing hygiene, disease control—and feeding. The best stock, however well bred and cared for, will not be an economic proposition unless their feeding is of a high enough standard for them to realize their full potential. It follows therefore that quality of food, related to the bird's requirements for high rates of performance, whether growth, fattening or egg production, is of paramount importance.

The food bill, accounting for at least 70 per cent of the total costs, is the major item in practically all forms of livestock enterprise today, and particularly in poultry-keeping. Any attempt to cut down on the quality of the ration is usually commercially disastrous, for margins of profit are necessarily geared to high level performance, and nothing has so adverse an effect on performance as inferior food. At the same time, if feeding costs can be reduced without detriment to productivity, obviously the margin of profitability can be increased.

Profitable poultry-keeping these days has become very much a matter of specialization and intensification, but we are all probably agreed that intensive forms of husbandry, so necessary for economic success, have brought in their train a host of problems of their own.

Of all forms of livestock, the domestic fowl requires the most concentrated and most expensive type of diet. It is, by the nature of its simple alimentary tract, very limited and restricted in its capacity and ability to cope with bulky and fibrous foods. The ration has to be concentrated in the sense of having a high energy value per unit weight, and there has to be a delicate balance between the levels of energy, digestible protein, vitamins and minerals. It has to contain a fairly high proportion of expensive animal protein foods; adequate minerals, so essential for the metabolic needs of the bird for bone growth and egg production; and it has to meet relatively high requirements for certain vitamins to maintain health under intensive living conditions and to promote and sustain growth and egg production, especially of eggs for incubating and hatching into strong healthy chicks.

Under less intensive conditions, some latitude is permissible in the make-up of rations; for birds with access to clean pasture, sunshine and soil are able partially or completely to compensate some food deficiencies with what additional nutrients they are able to acquire under these conditions. Where

birds are kept under very intensive conditions, the poultry-farmer must see to it that the ration, in all minor as well as major factors, is as complete as modern scientific knowledge and human endeavour can make it. The deficiency of a single essential factor may so adversely affect health or productivity that the economy of the whole enterprise is put into jeopardy. This need to ensure the completeness of the ration is a major problem in nutrition, and to provide an adequate margin of safety one is involved in a greater complexity and cost of the ration. It would therefore be wrong to underestimate the task of providing a nutritionally balanced ration or to assume that the consequences of inadequacy are unlikely to be reflected in performance.

The science of nutrition has made tremendous advances over the past twenty-five years and new discoveries are still being translated into practical use. It is no wonder that many poultry-keepers feel that the formulation of rations has become so complicated that the task is best left to the compounders of feedingstuffs and to those preparing mixed concentrates for blending in simple proportions with available cereals. But there are those who for various reasons prefer to mix their own feedingstuffs, and the position is greatly helped, of course, by the major advances in the types of available machinery for milling and mixing rations under farm conditions comparatively cheaply.

Two important questions arise:

(a) has the average poultry-farmer the necessary knowledge and skill to make up rations for his birds, complete in all essential factors and of sufficiently high quality to sustain the high production levels necessary for profitability?

(b) can he do the job both efficiently and economically?

To answer these questions we must consider in broad terms what the essentials are for a complete ration for any type of poultry stock. Although details will vary, there are certain principles common to every type of ration.

Basic principles

Poultry, as was said earlier, require concentrated rations—that is, rations high in energy in relation to their bulk, reasonably low in fibre and containing adequate levels of protein supplements, part of which must be of animal origin. The rations must contain adequate material matter and sufficient protective vitamin sources to cover the needs of birds under the most intensive conditions in which they are likely to be placed. We can list the main classes of ingredients necessary for their build-up as follows:

	per cent
Cereals	55 – 60
Cereal by-products	15 – 25
Animal protein foods	7½– 12½
Vegetable protein foods	5 – 10
Mineral and vitamin supplements	5 – 10

This basal formulation can be adapted to every type of poultry stock by breaking it down with further additions of cereals, and perhaps modifying the levels of the mineral and vitamin supplements. All this means, in effect, is a further cheapening of the basal ration; for of all the ingredients used, cereals are the least expensive, and some of the vitamin supplements the

most expensive items in the dietary. The basal ration, moreover, must not only be good nutritionally; to be fully acceptable, its texture must be suited to the particular class of birds to which it is to be fed. It must be palatable, it must be free from toxic and obnoxious ingredients and, finally, the individual component foods must be thoroughly blended. We must also include in our costs of such rations, not only the current value of the ingredients used as they leave or enter the farm gate, but also the costs of getting the ingredients into the form required for mixing and of the actual mixing operation.

Clearly, the cereal components form the major part of the ration, so on farms where sufficient cereals can be grown there is a ready means of cashing them by feeding them direct to livestock. The only limitation of this statement is that the proportion of oats (in a finely ground condition) must be limited because of their fibre content, which amounts to about 10 per cent. Even so, finely ground oats may replace the greater part of the middlings (up to 20 per cent of the total ration), thus making a saving on purchased foods. At the present time, maize for home grinding is a comparatively cheap cereal, so that the poultry-keeper who has to buy all his feedingstuffs can make a very effective use of it.

Formulae

The actual requirements of any poultry rations can be examined under the headings of:

(a) devising suitable formulae to fulfil nutritional needs;

(b) securing the necessary ingredients, either by purchase or by home growing;

(c) blending those ingredients into a suitable physical state as a nutritious, palatable and attractive feed by appropriately grinding them;

(d) actually blending these components into a uniform mixture either mechanically or by hand, and

(e) employing conscientious operators who will work strictly to the formulation laid down.

Getting a suitable formula these days presents no difficulties. Through the various officers of the N.A.A.S. and the numerous leaflets and bulletins available from the Ministry of Agriculture, it is a simple matter to obtain not only appropriate formulae for rations but also individual advice enabling the farmer to take full advantage of local circumstances. As examples, one may quote the making of the best use of surplus tail wheat, a dredge corn mixture or an unexpectedly good crop of beans. Alternatively, the farming and poultry press are usually only too glad to be of help.

As to the ingredients themselves, it is rare that all the components needed for a poultry ration are naturally available. Purchased ingredients may include additional cereals such as maize, cereal by-products (middlings), high protein vegetable foods such as ground-nut or soya bean meal, animal protein foods such as fish meal, meat and bone meal and dried milk, and the minerals necessary to complete the ration. Up to a very few years ago, most vitamin preparations were of the nature of empirical sources such as cod

liver oil, dried grass and unextracted dried yeast. Nowadays there have been such extensive developments in the field of synthetic vitamins such as A and D_3, riboflavin and so on that it is usual to buy them in a convenient form for mixing at, say, a 1 per cent level in the diet. The ration is thus readily made complete in so far as these factors are concerned. Minerals also can be bought either as "straights" (salt, ground limestone, steamed bone flour) or as ready-made mixtures which appear to contain anything and everything that has ever been shown to be necessary. And then there are the various additives, amongst which are the antibiotics.

Putting the ration together

We now come to those sections of the requirements that concern the actual putting together of the ration. Very rarely are all the foods available in a form suitable for blending into a uniform ration; some pre-treatment is usually necessary. For poultry foods, this usually means grinding or milling—moderately finely for most ingredients, and very finely for the more fibrous foods such as oats. This involves capital outlay in the shape of adapted buildings to house the mill and the appropriate source of power machinery, the installation of storage bins or hoppers, and so on. Mains electricity has been a great boon in this connection, and with the provision of automatic cut-out devices, the amount of supervisory labour is reduced to a minimum.

The preparation of the mix involves the provision of a weighing machine for the major ingredients, and scale machines for amounts up to 30 lb. The actual mixing is best done by a mechanical mixer if the farm is large enough; but we must not despise the use of muscle power and shovels to mix a batch of ingredients on the barn floor, nor condemn its efficiency. In these days you can get efficient mixers at a very reasonable cost, and they may well pay for themselves within a year or two. We have tested and analysed, bag by bag, the blending of a fairly complex ration in respect of both major and minor factors, and have been very favourably impressed with the thoroughness with which the modern mixer does its job. Further, let us remember that our knowledge of absolute nutritional requirements is still far from perfect, and one cannot accept that every beakful of food must be identical. This does not mean slackness in making up rations, but I think it is wrong to over-emphasize the necessity of *absolute perfection* in mixing. Even the compounders cannot achieve this, and the best we can hope for is that the rations which we feed shall reasonably accord with what may be predicted from their formulation.

A further point relates to the conscientiousness of the men who are actually doing the job of mixing. Given clear instructions, the necessary ingredients, the appropriate equipment for milling, weighing and mixing, the average farm employees are in no way inferior in intelligence, honesty or ability to their town counterparts who do the mixing in the large compound mills. Make sure that the man doing the mixing is given a clear flow sheet of what he has to do. You cannot reasonably expect him to translate a percentage formula into weights needed for the production of 5, 10, 15 or 20 cwt of a particular ration. Give him the tools of the job, tell him exactly in terms of weights what he has to mix, do one or two batches yourself with him, and then trust him to do the job.

Advantages of home mixing

What advantage is there to the poultry-keeper who mixes his own rations? Our farm-mixed ration is, of course, in the form of meal, but the time may not be far distant when some fairly cheap and simple machinery for making crumbs or pellets from meal may become available. These physical forms of food are, in certain circumstances, better for feeding to poultry, since meal feeding can at times be wasteful. But is it worth the extra time and trouble involved?

This is a matter for individual decision in the light of each farmer's circumstances. From the advisory angle, we start with no preconceived notions about home-mixing or purchasing compound feedingstuffs. There are many circumstances in which the best advice is to buy the ready-mixed materials. Where a poultry-farmer is fully utilizing his available labour and resources, there is often little alternative for him but to buy the finished product as it is to be fed. Where home mixing means employing new labour, where resources are already fully strained, where the quality of his labour may be in doubt, he would be well-advised to rely on the specialist manufacturer who, as we know, does a thorough and efficient job. At the same time, there are certain advantages in home mixing, either in doing the whole job or in part—that is, using proprietary supplements containing proteins, minerals and vitamins in simple proportions with available cereals.

The first advantage is that the farmer can usually make some appreciable savings on food costs without any loss of efficiency, even costing his home-grown cereals and other foods at the figure they would realize when sold. The full extent of these savings must vary circumstantially, and it would be unwise to hazard an average figure for them; apart from the direct costs of such items as the ingredients of the ration and the labour employed in grinding and mixing, so much depends on the costs of grinding, capital depreciations on buildings and machinery, the share of general overhead expenses and so on. A figure of 30*s*. per ton perhaps covers all expenses other than the direct food costs, unless a farmer has laid out an exorbitantly high amount of capital to mix a ridiculously low quantity of food in a year. It is not difficult to work out roughly the total amount of food required for a particular poultry enterprise in the course of a year, and from this to assess whether the installation of the extra machinery and equipment required for mixing rations is justified. I should put the figure of total usage at 50 tons or more per year.

The second point concerns the direct usage of much of the cereals that can be produced on the mixed arable farm. There may be occasions when the direct sale of say, a crop of barley for malting may be more profitable than direct usage. But we have to remember that handling and transport costs today are far from cheap, and to move 10 tons of cereals from the farm to a compounding mill in order to bring them back again in the form of 15 tons of compounds can hardly be said to be an economic proposition. Whether we like to admit it or not, those transport charges have to be included in the cost of the ultimate purchased complete ration.

A third point concerns the constancy of the rations. It is not difficult to calculate the food requirements of all forms of livestock in terms of periods of 6 or 12 months, and hence to assess the quantities of the various in-

gredients needed to make up the required rations. It is then a straightforward business transaction to purchase immediately or forward at regular intervals the necessary quantities of ingredients. Where the farmer has available the necessary amount of storage space, it pays him to buy advantageously those ingredients which are most likely to fluctuate in price over the period for which he is planning. By this forward outlook, he can preserve a constant make-up of his rations; where changes have to be made because of price or availability considerations, these can be made gradually without perceptible effect on the quality or composition of the ration.

I accept that there are many individual circumstances in which it may be the better policy to purchase ready-made foods or concentrated supplements for use with cereals in simple proportions. There may be individual problems of management, labour, equipment, storage space and finance that may decide a farmer against undertaking home mixing of his foods. But, as I hope I have shown, there is definitely a case for the farmer who wishes to explore the possibilities of mixing his own foods.

Chemical Renovation of Pasture

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Spraying with selective herbicides and surface reseeding of worn-out grass is a technique which may open up new economic possibilities in grassland husbandry.

THE permanent pasture of this country is usually a mixed community of grasses and broad-leaved plants, some desirable because they provide good bulk food for the grazing animal, and others undesirable for reasons of low productivity, nutritional value or palatability. Wherever improvement is proposed, it is always necessary to consider how the unwanted grass and broad-leaved weeds are to be suppressed. Broad-leaved weeds can be controlled successfully by a variety of cultural, mechanical or chemical methods; indeed, the main problem nowadays is to decide on the easiest and cheapest treatment.

For the control of grass weeds, reliance has had to be placed on cultural or mechanical methods, because chemical weed-killers with the necessary toxicity to grasses have not been available. Ideally two types of chemicals are required. The first is one that combines a high toxicity to grasses such as Yorkshire fog, bent, red fescue and tussock with a low toxicity to ryegrass, timothy, etc. (a chemical of this kind would permit selective grass control on permanent pastures and the maintenance of leys in their original composition). The other should be generally toxic to grasses, quick acting and with short persistence in the soil. Old pastures could then be destroyed and

the ground reseeded without ploughing, which may be difficult or expensive on wet, steep or shallow land.

In recent years, three chemicals capable of killing established grasses have become available, but unfortunately their toxicity is such that they cannot be considered for selective control. However, two of them, dalapon and amino triazole, are capable of killing an established sward. This knowledge has caused considerable interest in the possibility of reseeding pastures without heavy mechanical cultivations, and a number of experiments have been started in the past three years.

Experience has already demonstrated some advantages and disadvantages of the chemicals. The first one used in America, TCA (trichloroacetic acid) was reasonably cheap, and toxic to a number of broad-leaved weeds as well as the grasses. As it is only taken up through the roots of plants, it is slow acting under pasture conditions; moreover it is rather persistent in the soil. The toxicity of dalapon, provided 5–15 lb an acre is applied, is very high to grasses, but low to broad-leaved species. Although it is taken up through the leaves as well as the roots, dalapon is rather slow acting, but it persists for a relatively short time in the soil. One of its most useful properties is that it appears capable of killing grasses at most times of the year and, as a result, considerable flexibility in the timing of a reseeding operation is possible. Since dalapon has a low toxicity to broad-leaved species, it must be mixed with another chemical if total destruction is required.

The most popular chemicals for this purpose are amino triazole and 2,4-D (amine or ester). Amino triazole combines a general toxicity to broad-leaved species with a degree of toxicity to grasses; in mixtures it can, therefore, replace a small part of the dalapon dose necessary for grass control. Although slightly less persistent in the soil than dalapon, 2,4-D is extremely toxic to clovers sown too soon after spraying; 2,4-D applied in midsummer, gives a good control of broad-leaved weeds, and is much cheaper than amino triazole. But doubts have arisen about its activity when used at other times of the year, particularly in autumn—a popular time for spraying in sward-destruction work.

Three experiments

Results of investigations at three centres in England were reported to the British Weed Control Conference at Brighton in November 1958.[1, 2, 3]

The Agricultural Research Council Unit of Experimental Agronomy has been responsible for investigating the reaction of individual species to dalapon and amino triazole, and for testing the persistence of these chemicals in various soil types. In addition, a number of experiments have been started on different pastures to study the reseeding process following chemical destruction of the turf.

In an experiment on a Thames flood meadow which contained a mixed pasture population, 2,4-D ester at 1½ lb an acre and dalapon at 15 and 30 lb an acre were applied in June and September 1956 respectively: the treatments killed the sward completely. In the spring of 1957, light surface cultivations with discs, pitchpole or harrow were compared with ploughing; afterwards a timothy/meadow fescue/white clover seeds mixture was sown. In the initial establishment of the new pasture, spraying plus discing or pitch-

poling was superior to ploughing, because the seedbed was much firmer; but eighteen months after sowing there was little to choose between the two methods in the final sward produced. Another flood meadow, composed mainly of tussock grass (*Deschampsia caespitosa*), was sprayed in October 1957 with various mixtures of 2,4-D, dalapon and amino triazole. In April 1958, after the dead vegetation had been burnt off, the area received light surface cultivations, and was then reseeded. A good emergence and take of timothy and meadow fescue was obtained, but the white clover was killed by unexpected flooding in June.[1]

By contrast, the Grassland Research Institute carried out an experiment on a downland pasture composed largely of red fescue and broad-leaved herbs. In May 1957, mixtures of amino triazole at up to 10 lb, dalapon to 3 lb and 2,4-D ester to 1 lb an acre were applied; eight weeks after spraying, the plots were cross-harrowed and sown with ryegrass and white clover. The chemical treatments were intentionally sub-lethal, and only a temporary check was given to the established herbage. After sowing, the red fescue regenerated to a greater degree than was desirable, which indicated that a higher dose of chemical should have been used. The most effective treatment, in terms of seedling development, was a mixture of 3 lb dalapon and 1 lb 2,4-D ester; following this the specific frequency of ryegrass was 22 per cent in April 1958, compared with 9 per cent on the unsprayed sown plot.[2]

The East Midland region of the N.A.A.S. carried out experiments in which 10 and 20 lb dalapon plus 1½ lb 2,4-D ester per acre were applied in the autumn of 1957 to difficult swards of wet and hill land. Most of the species found, *Deschampsia caespitosa, Molinia, Nardus, Holcus mollis, Agrostis* spp., *Calluna vulgaris* and *Cynosurus* spp., were growing on fibrous or peaty root mats. With the exception of *Holcus mollis*, all the grass species were killed by the high rate of dalapon, but the kill of broad-leaved species achieved by 2,4-D ester was unsatisfactory. In future it may be necessary to consider a split application, the 2,4-D being applied at the most favourable time in midsummer and the dalapon being used in the autumn. In the spring of 1958 it was felt that the seeds should not be sown into the poor seedbed provided by an undisturbed root mat, and attempts were made to cultivate or tear up, the fibrous material, but it was difficult to obtain seedbeds under such conditions. It was concluded from these experiments that chemical renovation was easiest where conditions were similar to normal lowland farming, and that as the land became more difficult the technique became less practicable.[3]

Besides these three centres, the West of Scotland Agricultural College and the Hill Farming Research Organization have experiments in progress in southern Scotland, but as yet only preliminary results have been published.

Interest in New Zealand has centred around the steep hill slopes which are often dominated by bent (*Agrostis* spp.), but are capable of carrying more productive species. There have also been experiments on flat land in which spraying, followed by surface reseeding, has been compared with normal cultivation. In the early trials on hill land, 5 lb an acre dalapon, alone or mixed with 1 lb an acre amino triazole, was the dosage most favoured; but more recently rates of application have been increased to ensure a better kill of the turf—up to 10 lb dalapon plus 2 lb amino triazole

per acre. PCP (pentachlorphenol) has been added to dalapon to give a quick, scorching effect, but the final kill was found to be reduced.[4]

The chemicals were applied both by a ground sprayer and from aircraft. In an experiment on six acres of steep hill country, a Tiger Moth applied 5 lb dalapon plus 1 lb amino triazole in 22 gallons of water per acre. Twenty days after spraying, 3 cwt an acre superphosphate and 53 lb pasture mixture were sown, then later on 15 cwt an acre of lime was applied. A reasonable overall kill of turf was obtained, but it was not as good as that resulting from the same amounts of chemicals applied from the ground. There was a good initial strike of both grasses and clovers.[5]

Apart from the grass/clover mixtures which have been tested, attempts have been made to sow cereals, lucerne, fodder beet, brassicas and turnips, but little success has been achieved with crops other than grass/clover mixtures. Two troubles encountered were losses caused by birds where the seed was not covered by cultivations, and damage to the seedlings from slugs which were in the old turf. New Zealand opinion is that the technique is potentially very useful for hill land, but it must still be considered to be very much in the experimental stage.

Application of the technique

The basic essentials for the preparation of a seedbed are the destruction of unwanted herbage, the burial or removal of rubbish which may interfere with sowing, and the production of a suitable tilth into which the seed may be sown. A herbicide treatment can directly bring about only the first of these requirements, while on the second it can have only an indirect influence. An autumn kill of live vegetation, which is to be followed by spring sowing, will allow up to five months for the vegetation to collapse and decay, and this may lead to an organic seedbed or to an easy exposure of the soil surface. Alternatively, the death and desiccation of a large quantity of vegetation may permit burning. On the other hand, in some of the experiments the destruction of herbage by a chemical has made the disposal of surface rubbish more difficult. The use of a herbicide cannot directly influence the production of soil tilth, but it is interesting that on some of the old permanent pastures that have been treated, there was in the top inch or so a tilth that required only exposure to provide the necessary conditions for germination.

Spraying and surface reseeding may be applicable to a wide range of pasture conditions, varying from ley farming of the lowlands to the steep wet slopes of hillsides. On lowland farms, ploughing as a method of obtaining a seedbed is a long-established practice to which management and machinery are geared. Chemical renovation will be acceptable only if it can be shown to be easier and cheaper, or that a more satisfactory establishment can be obtained by spraying and surface reseeding than by ploughing. From present experience it is impossible to make any reliable comment on this comparison.

On hill pastures the situation is less settled. Those experienced in the grassland husbandry of hill areas are tending to move away from costly ploughing operations in favour of slower, but easier, methods aimed at bringing about gradual changes in sward composition through the use of fertilizers,

drainage and controlled grazing. From recent experiments on chemical renovation of hill pastures, it seems that a total herbicide which can hasten the departure of the old species, followed by the broadcasting of seeds or seed cleanings which could be trodden in by sheep or cattle, might well be a useful method of improvement. If this treatment proved worth while, it would have to be fitted into the rather complex system of subsidies that operate on marginal land.

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Developments in Farm Grain Drying and Storage

C. CULPIN, M.A.

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The size of the harvest, local climate and the money available are three factors which need to be considered before grain drying and storage plant is installed.

OVER the past few years many more grain driers have been installed on British farms, reflecting the greater use of combine harvesters and the displacement of binders and stationary threshers. Unfortunately, it is no easy matter for a farmer to decide which kind of drier is best suited to his needs. There is inevitably a good deal of argument, some of it not well-informed, and it is not easy, in a short article, to bring out all the points that should be considered by farmers who want either to install a new plant or improve an old one. But this is such an important question that it is worth while to consider some of the factors that need study.

Capital and other costs

Capital invested in providing grain drying plants should always be kept within reasonable bounds, since the need is so seasonal and the operation cannot be regarded as productive, except in making it possible to market sound grain at any chosen time and take advantage of the seasonal price rise for wheat.

Fixed costs (chiefly depreciation and interest on capital) generally represent from one-half to two-thirds of the total operating cost, and there are very wide differences between plants according to the equipment chosen

and the extent to which it is fully employed. With tractors, a reserve of power is often a valuable asset, but provision of more grain drying capacity than is really needed in a wet harvest is a sheer waste of capital. Contract drying for neighbours can, of course, help to justify fairly expensive equipment on a small farm. Experience in Hampshire also indicates that, provided everything is well planned, drying and storage can be economically handled by a Farmers' Machinery Syndicate.

The equipment should always be so planned that operating the drier does not create unnecessary labour difficulties. On small farms it is obviously a great advantage to have equipment that will run for several hours unattended, whereas on big farms it may be easy to justify having a man in almost constant attendance. This consideration, along with that of low capital cost, makes simple batch driers or ventilated bins attractive on many smaller holdings.

The importance of fuel cost varies according to the amount of drying needed and the type of plant. It need never be a very serious worry, provided the equipment is suited to the conditions and well managed; but it can add up to a considerable sum if the installation is unsuitable and badly managed.

Heating by electricity, though expensive in terms of cost per British thermal unit, can be justified in plants such as ventilated bins, where the need for heat is small and any heat supplied is used effectively. In such plants typical electricity consumption is about 18 units to dry out one per cent moisture from one ton of grain, and the average running cost is not more than about 7*s*. 6*d*. a ton. Oil-fired continuous driers are cheaper in fuel cost. They use about half a gallon of diesel oil to remove one per cent moisture content from one ton, and to remove five per cent costs about 3*s*. 4*d*.

Choice for wet districts

In wet districts, where grain almost always needs an appreciable amount of drying, the choice lies between a continuous-flow drier, an oil- or coke-fired batch drier (including small-diameter radial silos), or an all-electric platform drier, which may also be made suitable for hay drying. As a general rule, the continuous-flow drier is unnecessarily expensive for dealing with limited quantities of grain, so on small farms the batch types are rightly preferred. A wide range is now available, including tray types which are very easily installed. Complete platform driers can be bought and quickly installed on a flat floor in a similar way. Many farmers have taken advantage of the introduction of units for providing the necessary warm air and have successfully built their own batch driers. The sloping tray type is popular and easy to build, and if it is well planned, with a suitable wet hopper above the drying tray and a dry grain hopper below, the plant can be made to operate almost continuously with a minimum of attention. Such batch driers, whether home-made or ready manufactured, can be powered by tractor-driven, engine-driven or electric fans, and heated by oil, coke or electricity.

The amount of grain that a well-designed plant can dry is substantial. Simple batch driers and platform driers can easily be designed to dry 200 tons a year—so there is no difficulty in catering for the quantities normally handled on small farms. Drying capacity naturally depends primarily on the fan and furnace provided, and N.A.A.S. Machinery Advisers will be pleased

to help farmers who are not sure what capacity they need or can get from various types of equipment. Continuous-flow driers will usually be preferred where fairly large quantities are to be dealt with and the job must be done quickly. A notable recent development has been the appearance of several new continuous-flow driers which dry from 10 cwt to 2 tons an hour by 5–6 per cent moisture content. These driers are, on the whole, reasonably priced, and are now almost invariably designed with built-in elevators which make it possible to install them without any excavation. This, of course, greatly simplifies and cheapens installation, and farmers who are choosing any size of drier today should bear it in mind.

Ventilated bins in dry areas

The problem of choice in dry districts is complicated by the fact that ventilated silos of various types should be considered. For the purpose of this discussion, a dry district may be regarded as one in which most of the grain can be harvested at not much over 20 per cent moisture content. Individual farmers' opinions on the decision between ventilated bins and continuous-flow driers naturally tend to be unduly influenced by the choice that they themselves have made. The farmer's opinion is valuable when it relates to the type of plant he uses, but it may not be very helpful to seek views on ventilated bins from a farmer who uses a continuous-flow drier, or vice versa.

Unbiased study of the problem shows that in dry areas either type of plant can be quite satisfactory, provided it is well designed and well suited to the general farm management needs.

It is sometimes assumed that ventilated bins over a certain size are not worth considering, but there is no good reason for this idea. Ventilated bin plants of 1,000-ton capacity have proved quite successful, though at such a size it is convenient to plan the ventilation with two units which can be used independently on the two halves of the plant when necessary. It is also a considerable advantage, with a very large installation, to have a small continuous-flow or batch drier in the set-up, so that a small amount of grain may be dried quickly when necessary, or the drier used to take a little moisture out of very wet samples in a bad season. The combination of a small continuous-flow drier with ventilated bins for storage may, indeed, be ideal for a large farm in dry regions, where a considerable amount of bulk storage is needed—especially if the ventilating equipment is to be used to condition baled hay or ventilate potatoes stored in bulk. Suitable lean-to accommodation for these jobs can often be built comparatively cheaply alongside the grain silos. Experience in 1958 confirmed that ventilated silo plants designed in accordance with N.A.A.S. recommendations, as detailed in the Ministry's Farm Machinery Leaflet No. 13,* can deal effectively with the worst conditions we are ever likely to encounter.

Where the aim is rapid drying and there is no need for bulk storage, a continuous-flow or batch drier is, of course, cheaper and more suitable. Ventilated radial silos tend to come between vertical air-flow ventilated bins and simple batch driers. Using silos of 7 feet 6 inches diameter and a high rate of ventilation, it is often possible to dry batches in a day or so.

* Ventilated Silo Grain Driers. Obtainable, free, from the Ministry (Publications), Soho Square, London, W.1.

Importance of good layout

It is impossible to over-emphasize the importance of a good layout, whatever type of drier is involved. Even with a simple platform drier, successful operation depends largely on the ease with which sacks can be handled on to and off the drier. An ideal arrangement is to house the drier in a fairly large building, and have plenty of smooth-surfaced storage space level with the top of the platform.

With more complex installations, such as a small continuous-flow drier with bulk storage, it is usually desirable to have one or two self-emptying pre-drying bins. These can often be used, with a pair of high-capacity elevators, to provide for loading out grain in bulk.

Bulk handling

Bulk handling of grain can pay, whatever the size of farm. But the equipment required to make it work needs more capital than many farmers can afford when first they buy a combine harvester. So while bulk handling is steadily spreading, well over half the combine harvesters sold recently have been equipped for handling grain in sacks.

Wherever bulk grain storage is provided at the farm, it is worth while to aim at bulk handling, both from the combine and to the merchant. The equipment needed is not expensive, provided that the whole thing is planned before the store is built. In some circumstances a prefabricated overhead hopper may be installed, above or near the grain intake pit, and fed by the main elevators. In others it is cheaper to use one or a pair of self-emptying silos at ground level, and to have elevators of sufficient capacity (15–20 tons an hour) to ensure that road transport can be loaded quickly.

Building problems simplified

The problems involved in building grain stores have been considerably simplified by developments in prefabricated silos, and in such items as conveying equipment. Prefabricated silos made of steel, reinforced concrete or timber have been so much improved that there is very little to be said for building typical farm plants in masonry. Some of the silos are designed to carry their own roof, and this can often help to solve the storage problem efficiently. Unless a good Dutch barn or something comparable is available, there is usually nothing to be said for trying to fit bulk grain storage into existing barns. No side cladding is needed where a suitable type of rectangular steel silo is used, and all that is usually saved by building inside an existing barn is the roof itself.

Two points need especially close attention. First, the design of the foundation or raft which is required to carry the heavy imposed load of grain storage. This applies particularly where the store is to be erected on shrinkable clays, fen soils or silt. It is well worth while to obtain expert advice. Second, ground water getting into pits and ductings can be a source of annoyance and expense. Either asphalt tanking or the insertion of welded steel tanks can prevent this trouble. Designs that will eliminate deep pits, such as a long narrow reception pit which can be emptied to the foot of the elevator

with an auger conveyor, are being developed. High-speed inclined auger conveyors, which work in the grain pit itself, make it possible to avoid altogether the deep pit that is required to house a bucket elevator. Similarly, conveyor passages and trenches can be dispensed with by using auger conveyors to empty the storage silos, and this makes it possible to avoid trouble where the water-table is within a foot of the surface. These are steps in the right direction, for troubles from a high water-table are all too common.

Ventilation and dust

The air leaving any type of grain drier is laden with moisture, and should be taken out of the building as quickly as possible. The best way is by effective natural ventilation of the roof space through big openings in the gables or by the use of roof ventilators. Fans to remove the air should be necessary only where the plant has had to be housed beneath an unsuitable roof. The aim should then be to achieve a through flow of air and to avoid having extractor fans working against one another.

Dust can be a serious nuisance in a grain store, and in a season such as 1958 can sometimes cause serious illness. There is usually no single cure for an excessively dusty grain store, but the sources of trouble are often cleaners and conveyors. Aspirating cleaners are comparatively easy to deal with. The simple winnowing type is more difficult, but the solution is to box it in and arrange for the exhaust air to be delivered outside the building, if possible. It is often easy also to box-in the junctions between elevators and conveyors. Sources of dust which cannot be dealt with by boxing-in, such as where a conveyor discharges into a bin, can be connected by ducting, for example light, galvanized, rainwater piping, to a centrifugal fan which takes the dust-laden air out of the building.

Damage to grain

It is possible with most of the new continuous-flow driers to damage seed corn or malting barley, or even wheat for milling, by the use of too high temperatures. The recommended maximum air temperatures for barley and seed corn are 120°F for corn of up to 24 per cent moisture content and 110°F for corn of over 24 per cent. For milling wheat, the temperature should not exceed 150°F. New operators should resist the temptation to exceed these temperatures to speed up drying.

In 1958, however, more grain was spoiled by lack of drying than by wrong drying techniques. Very damp grain will often spoil if kept for a long time, even if it does not heat, and farmers should try to arrange to get drying done at the earliest possible opportunity.

The next few years are likely to bring refinement of existing methods and machines, rather than the development of basically new equipment. The possibilities of such methods as the use of infra-red electric heaters are being examined, but any revolution in drying methods is most unlikely. One of the most interesting fields for progress will be the development of methods of integrating grain and hay drying, to make the greatest possible use of fans and furnaces.

Shelter for Horticultural Crops

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Protection will cost money, work and space, and to make the most of it will call for a knowledge of the behaviour of wind and the crops to be grown.

WIND affects horticultural crops more than is generally realized, and less account is often taken of it in planning a horticultural holding or a cropping programme than of other factors—frost and rain, for example—which are usually more obvious. Frosts can be expected in this country between certain fairly well-defined dates in the autumn and spring; they come early or late according to locality, but are reasonably predictable. Drought is rather less regular, but affects growth more in the late spring and early summer than at other times.

Wind strikes at any time of the year and from any quarter. It is also more erratic in its effects, and some parts of the country are much more liable to damage than others. Wind from one quarter may cause damage on a site where wind of a similar strength from another may do little harm because of shelter from surrounding hills or trees, or other shelter provided in time gone by. The benefits of such features may not be fully appreciated unless, in the case of trees, they begin to fail or are felled to leave exposure in the place of shelter.

The effects of wind on horticulture and horticultural crops are many and widespread, and the following summary emphasizes the need for shelter.

Damage to plants

The most obvious wind damage is often that which occurs infrequently in districts where persistent winds are unusual. The removal or bruising of almost ripe crops of tree fruit, breakage of glass in glasshouses, lights or cloches and the occasional shattering of flower crops are all accepted as serious losses against which little effective action can be taken. There are many other ways in which wind can cause loss or trouble to horticulturists, for instance by the reduction of spraying time and decreased efficiency of spraying carried out in even light winds. The latter is particularly troublesome when damage to neighbouring crops may be caused by drift from low volume spraying.

Fruit trees need stronger and more careful staking on windy sites, and pollination of the blossom is less satisfactory in windy weather. The wind both deters pollinating insects and damages the flowers.

Wind rocking of fruit trees causes puddling of the surrounding soil and damage to the roots, the combined effect of which can kill affected trees. Many brassicas and other vegetables die or are severely checked each year for the same reason. The foliage of some other vegetables, such as potatoes, beans and lettuce, can be blackened by strong winds, and in extreme cases

seedlings and young plants may be blown from the ground with the surface soil in which they were growing.

The removal of valuable surface soil in this way is an increasing risk on the flat, light lands of eastern England, where there has been a tendency to remove what little shelter there was, so that every available square yard of soil can be used, and ample scope provided for the use of machinery. The loss of soil not only reduces the value of the land but the blown soil is troublesome and expensive to remove from nearby roads and watercourses. In many exposed situations, the movement of soil particles also causes damage as they are blown against tender foliage.

Damage to flowers and foliage plants, whether they are being grown for sale or for ornament where they grow, is no less serious than to other crops. Such crops sell entirely on appearance and the slightest wind-rubbing of blossom or foliage can cause serious loss. Such damage may also make the plants more susceptible to attacks by fungus diseases. Some plants may be less susceptible in the winter, but the additional damage caused by frost, and by the burden of snow, makes wind at that time a most serious menace to many.

The most obvious effect of wind in exposed districts is the shaping of trees and shrubs. This may be due to persistent winds, which bend the young, pliable shoots for so long that they lignify and remain permanently in this bent position, or to occasional strong winds which, particularly if they are salt-laden, scorch the young shoots or even remove them completely from the tops and windward sides of the trees. Very few such severe gales may occur each year but in the spring, when new growth has started, the effect on the subsequent shape of the trees can be devastating. Shoots on the sheltered side will continue to grow more or less horizontally in their original direction, but the remaining growth may be killed, in some cases back to two- or three-year-old wood. Trees affected in either or both of these ways produce the typical almost horizontal outline, which in extreme cases is considerably longer than it is tall. In less extreme situations, fruit trees may still assume shapes which make pruning difficult, and many of the modern varieties of apple in particular are very prone to branch breakages.

Damage to dead stock

In addition to these many adverse effects on plant growth, wind has a considerable effect on the dead stock of horticultural holdings. In extreme cases, building costs may be raised because of the need to take extra precautions to ensure the safety of the roof, windows and doors, and prevent rain getting in at these points. Apart from the risks of breakages of glass already referred to, the heat loss from glasshouses and other buildings is greatly increased on windy sites.

This outline of the direct effects of wind does not complete the story. The indirect effects, in reducing air and soil temperatures and removing moisture from plants and soil, must be taken into account. In sheltered areas, temperatures are usually higher and moisture losses lower, and many horticultural crops grow better in such conditions; shelter from wind can, in fact, produce some of the conditions provided by glasshouses, frames and cloches, and adds to the value of such glass by reducing heat loss from it.

Type of barrier important

To make the most of such shelter as is necessary calls for a knowledge of the behaviour of wind and the crops to be grown. The form of barrier is important: while a solid barrier provides very effective shelter immediately on its lee, it produces less shelter farther away, and the amount of air turbulence produced may be more damaging than the original wind. A shelter which approaches the theoretical ideal of about 40 per cent aperture to 60 per cent solid is the most effective.

The distances between windbreaks will depend on their height and the crops to be sheltered. It is usually agreed that the speed of the wind is reduced in the area up to two or three times the height of the shelter to windward, and to some twenty times the height to leeward. A windbreak 10 feet high will check the wind from some 30 feet to windward to 200 feet to leeward of the shelter. The maximum protection, however, is obtained close to the lee of the shelter and up to some five to seven times the height to leeward of the windbreak. Thus the shelter 10 feet high would effectively protect some 50–70 feet. For delicate horticultural crops in exposed situations, the distances between windbreaks should not exceed ten times their height; seven or even five times might be better.

While the main shelter will be arranged to protect crops from the prevailing winds and is often, therefore, in parallel lines approximately north to south, it may also be necessary to provide shelter from winds from other directions. A satisfactory method of doing this is to provide permanent shelter in lines roughly north to south, between which mechanical cultivations can be undertaken, and then to provide temporary living or artificial shelter in lines east to west, which can be removed after the crop needing shelter has been harvested. The alternatives of providing either temporary or permanent shelter on all sides are not so satisfactory, except in very special circumstances, the former because of the expense and the smaller effect, and the latter because cultivations are considerably hampered in the necessarily small rectangles thus produced.

Methods of providing shelter

Wind is not by any means the only factor to consider in choosing a site for a garden or farm, but it should certainly receive careful attention on any site being considered for the production of horticultural crops. Few sites will be completely sheltered by surrounding hills or established trees, and some form of added protection will often be needed. This may be provided in several ways. To give protection over the greatest area, shelter-belts are often used, but they take a long time to grow. They can be defined as two or more rows of trees normally permitted to grow untouched to their natural height. As part of a long-term policy for improving almost any horticultural holding, the provision of shelter-belts has much to commend it. Few trees, however, can be expected to provide much effective protection for any great distance in less than ten years, and on small holdings the amount of land devoted to such belts may be too high a proportion of the whole. Some trees which may otherwise be useful send their roots to considerable distances and may thus interfere with drains and cultivations; the latter difficulty may

now in many cases be overcome by the periodical use of heavy mechanical cultivators along the margins of the belts.

Providing protection over shorter distances, but becoming effective rather more quickly, hedges are of great value in horticulture. A hedge may be defined as two rows, or preferably a single row, of trees or shrubs either naturally compact or, more usually, trimmed to a definite width and height. Some plants used as hedges can provide good protection within a few years of planting; others may take longer but can remain effective for many years. The cost of producing a hedge depends largely on the ease of propagation of the plant being used; if cheap seed can be used which will readily germinate in the open and soon produce satisfactory plants, or if the plants can be raised from cuttings easily rooted in the open or by some other cheap method, then first costs should not be too high. But if seed is difficult or expensive to obtain, slow to germinate, needs to be sown under glass, or if other expensive methods of propagation must be used, then the initial cost is bound to be higher. Some plants, however, may in the long run be worth the extra initial cost because of their long-term effectiveness as windbreaks.

Hedges, like shelter-belts, occupy some of the land of the holding; the value of this land, the plant food and water they take from the soil, the cost of weeding in the first year or two and the annual cost of trimming must be treated as the costs of providing shelter. In some cases also, the hedges may need spraying at the same time as crops, to control pests which inhabit them. On some sites they are essential, and on many they add greatly to the earliness, quality and quantity of the crops produced. Permanent shelter may also be provided quickly, but expensively, by the erection of walls or fences; if solid, such windbreaks have certain disadvantages, which have been mentioned already.

Shelter may be obtained by the erection of temporary fences. Constructed of wattle, laths or other thin timber, of coir netting, hessian or fine mesh wire netting, such fences may be used for particularly wind-sensitive crops and then removed to allow large-scale mechanical cultivations to take place. Such temporary shelter may also be provided by the production of *shelter crops* such as Jerusalem artichokes, kale and winter cauliflower, which themselves yield some cash return and at the same time protect more tender plants from strong winds.

The effects of soil erosion may be reduced, or erosion prevented, by the partial burial of crop debris or trash in susceptible situations.

Suiting the shelter to the site

Almost every site will have features and requirements which will need special consideration, if the most effective shelter is to be provided economically and with the minimum of interference with the work of the holding and the growth of the crops.

All effective shelter casts some shade, and for this reason shelter-belts which must run from east to west, other than those on the north of a holding, are perhaps best placed on the south of any roads or tracks. The land on the north side of shelters will be too shaded for the growth of most plants, but the access roads can make good use of such ground. In the same way,

east-to-west shelter-hedges can be so placed as to allow access paths to run along their north sides.

A windbreak placed across a slope will effectively prevent the fall of cold air to the bottom of the slope and will thus create a frosty area on its upper side when radiation frosts occur. To prevent this in districts where such frosts are likely to cause damage, and where susceptible crops are being grown, openings should be left to allow the cold air to escape; or the shelters may be placed diagonally across the slope, thus allowing the cold air to run away from the crops being sheltered. In exposed districts, shelter is needed from winds from all quarters. A cellular or square layout of the shelters, spaced in the way described above, is necessary.

Artificial shelter, whether permanent or temporary, may be provided immediately, but carries a high initial cost and, in the case of temporary shelters, is costly to remove and re-erect. Temporary crops as shelter occupy a high proportion of the land, are not always effective, may carry pests and diseases harmful to the main crop or a subsequent one, but may give some return by their sale or use as animal fodder on the holding.

Shelter-belts may be slow in becoming effective, occupy more land than their sheltering qualities may justify for a time, but in the end they may produce valuable protection, with a long life if well cared for. Hedges become effective more rapidly than shelter-belts and can remain so for many years: on the other hand, they interfere with mechanical cultivations and are expensive to plant and maintain.

The choice of trees or shrubs for such purposes will depend entirely on climate, soil, the use for which they are intended and the cost of the young plants. For winter crops, evergreens are probably essential; for summer crops deciduous trees or shrubs may have advantages. Species which thrive and make useful shelters inland may be quite unsuitable near the sea, while those which survive the strong salt-laden winds on the coast may not withstand the harder frosts experienced inland. When considering plantings for shelter, study local hedges and other trees and shrubs of potential value, or seek advice on the subject.

The most satisfactory distances between plants will vary according to the species chosen; valuable advice on this subject may be obtained from officers of the Ministry of Agriculture.

When hedge planting, a single line is nearly always as effective as a double one, and certainly much easier to keep weed-free in the first years. This is important; weeds should certainly be kept down by mechanical cultivations, hand weeding or spraying with suitable selective weed-killers until the hedge is old enough to smother such competition. Even when it is established, such weeds as ivy, brambles and unsuitable trees or shrubs are best eliminated from time to time if the hedge is to remain uniformly effective.

Shelter is essential for some horticultural crops in some districts, and desirable for most in many places. It will cost money, labour and space to provide, but by using existing knowledge on the subject, effective shelter can usually be made available in one of the ways described.

Autumn-hatched Chicks

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Given the right kind of lighting pattern, there is no reason why autumn chicks should not do every bit as well as spring-hatched chicks.

IN the last three or four years the pattern of the seasonal sales of day-old pullets for egg production has gradually shown significant changes. For decades the demand of poultry-keepers has been for spring-hatched chicks, and the peak of the hatching season has been in March or April. This year the peak of the hatching was in January, and by the end of that month almost half the 1958–59 sales of pullet chicks had been made. This departure from established custom prompts an inquiry into the reasons for the former reliance on spring-hatched birds and the conditions arising in the poultry industry which have dictated the change.

Undoubtedly in the past, when the fowl's average egg production was much smaller than today, spring-hatched chicks were not only the easiest but probably the only ones obtainable. Brooding was virtually dictated by the availability of broody hens, and the weather was a potent factor influencing the chicks' survival. The fact that for so many years there was no alternative to the spring-hatched chick has no doubt been responsible for the belief that chicks hatched at this season were to be most prized, even when the availability of hatching eggs and developments with brooding made production possible at other times of the year.

There is still a firmly-established belief today that a late-hatched chick (that is, one hatched about June or July) is very much inferior as a layer to the spring-hatched bird. Some of this distrust of the value of the former as a layer has also been attached to the autumn-hatched chick. But, for economic reasons, reluctance to accept very early-hatched birds is disappearing. Since it will be argued that the time of hatching can have a marked influence on the bird's subsequent egg production pattern, it is worth inquiring whether the time of hatching does in fact have any influence in the bird's potentialities. It is the widely-held belief that the late-hatched chick is a weaker bird than the spring chick. This view seems to be based on the opinion that the later the hatching, the weaker the chick from the standpoint of stamina. It is true that stock kept mated throughout the twelve months usually shows a decline in fertility as the season advances. But the hatching rate of fertile eggs shows no such seasonal change. However, if age were a factor in influencing stamina and productive ability, then it could be logically argued that the autumn-hatched chick should have advantages over the spring-hatched bird.

Investigations have not shown any differences in the chemical constituents of the hatching egg, and it seems that as long as the hen receives the necessary nutrients, vitamins, etc. regarded as essential for hatching, the needs of the chick embryo are met. In any case the productive capabilities and

other inherited characters are controlled by the genes which the chick receives from the parents, and there is certainly no evidence to suggest that these are impaired by age.

The light factor

Recent research work on light now offers a reasonable explanation why the summer-hatched chick frequently appears to be a "poor doer" and why the autumn-hatched bird may sometimes prove disappointing. Briefly the several workers on light and its influence on the fowl appear to have reached the conclusion that relative changes in the amount of light—whether natural or artificial—are far more important than the absolute quantity of light. Light influences the rate of sexual maturity and later the level of egg production. Experiments with chicks hatched at various stages have indicated that those hatched in December (that is, the period of the shortest natural day) reach sexual maturity substantially before those hatched in July. It will be appreciated that in the former case the chicks are being reared over five or six months when the natural light is steadily lengthening; in the case of the chicks hatched in July the reverse applies.

These findings may well explain the slow maturing of chicks hatched after the spring. With spring-hatched chicks, the length of natural daylight is certainly beginning to shorten in the last few weeks of their juvenile life, but it may well be that this is offset by the good manager who houses his stock and subjects them to artificial lighting in time to avoid the consequence of the naturally shortening daylight. When, however, we are dealing with autumn-hatched stock, the birds—if receiving only natural daylight—are subject to a light régime involving a shortening day up to the first two months of its life and then a lengthening day continuing up to maturity. Whether or not the autumn-hatched adult bird is housed intensively, it will be receiving after housing an increasing daily amount of light with a maximum of about fifteen hours' natural daylight. During this period—from point of lay until the late summer—egg production with the autumn-hatched birds is usually eminently satisfactory under normal management. But by mid-autumn many of these birds begin to flag heavily in production, and not a few farmers have had the experience of the birds going into a moult and falling out of production.

Over the last three years or so many farmers have bought autumn-hatched chicks, reasoning that they should be in full production in July and still laying at a high level in November—both being periods of a slump in egg supplies and consequently times of high prices. The November trough in production can be attributed to the seasonal decline in range flocks—again the effect of declining natural light—and we still have about one-third of our poultry population managed under the extensive systems. The midsummer drop in egg production seems to be due to the clean-out of many deep-litter houses at this time of the year, before housing the new season's pullets.

The disappointment of some poultry-keepers over the fact that their autumn-hatched chicks do not succeed in maintaining their promising high level of egg production during the autumn seems likely to be related to the light régime these birds encounter after reaching maturity. It has already

been pointed out that within about two or three months of the birds starting to lay, the natural daylight is probably about fifteen hours. If the birds are under range conditions the period of the natural daylight is markedly shortening by the late autumn. If the birds are housed in deep litter or in cage batteries and are subject to artificial lighting, it is unlikely that the artificial "day" so produced will be in excess of twelve or thirteen hours. It will be appreciated that under these conditions the stock will have been subject to a decreasing light-day which—on the theories advanced—will have begun to depress egg production.

Support from Edinburgh experiments

Research work recently concluded at Edinburgh supports this view. In this experimental work birds receiving 12 hours' light after point of lay were compared with birds receiving 23½ hours. After two months the light "day" of the latter was reduced to 12 hours. But in spite of this reduction giving them the same length of "day" as the control group, egg production fell and the birds moulted, while the control group continued to show good production. These findings, that the important factor is the relative amount of light and not the absolute amount, are now receiving further support from several quarters, and appear to offer a sound explanation for the behaviour of many batches of autumn-hatched chicks the following autumn. To a lesser degree, ordinary spring-hatched chicks subject to a constant 12–13-hour "day" after housing evince the same pattern, for while a sharp rise in egg production is manifest after housing, it is customary for the egg production to show a steady—if small—decline from the autumn onwards.

Experimental work, based on these hypotheses, has been carried out with controlled lighting from day-old until the close of the first year's laying cycle. In one such experiment the chicks received a six-hour day until maturity and afterwards a gradually increasing light-day until 18 months of age. This régime resulted in a *consistently* high egg production pattern.

It may well be that in the future fowl will be subject to controlled "day" lengths from brooding onwards. But such a policy would necessitate windowless houses and all-intensive management. Such developments are already taking place, but are likely to be beyond the pocket of the smaller poultry-keeper. The best advice to farmers who have to adapt existing plant would seem to be that they should endeavour to avoid reducing the "day" length and, if possible, increase it from just before point of lay until the laying cycle is completed.

Later stages of rearing

The most difficult time will be the later stages of rearing. There is still a good deal of reluctance to embark on intensive rearing—apart from the heavy capital costs of buildings. The best plan would seem to be to house the birds early—that is, well before point of lay. By this means autumn-hatched chicks, bought in November and aged four to five months by early April, will not have experienced the longest natural day. If they are housed at this stage it would not be too costly to limit effectively the amount of light received to either 12 hours or the natural day-length at housing, whichever is

the less. At point of lay a twelve-hour day should be initiated with a small increase—say 15 minutes—every week. The birds will thus be subject to a steadily increasing light pattern which, while not closely paralleling the precise experimental work described, should help to avoid the late autumn depression in production.

It will be realized that the treatment suggested essentially requires the adult birds to be housed intensively; range methods afford no way of effectively controlling the light pattern. It would also be of great help in managing autumn-hatched stock to ensure high summer and November egg production, if the rearing could be carried out under the intensive system. At present there is still a good deal of opposition to this by the more traditionally minded, although there is no evidence from a mass of experimental work that birds intensively reared later fail to equal their range-reared sisters in viability, egg production or egg weight. This is so when the adult stock is housed intensively—and for autumn-hatched birds no other system is economically feasible.

Since autumn-hatched birds are reared during the most inclement weather of the year, there seem strong arguments for adopting intensive rearing. With the most common rearing methods followed, it will be appreciated that the unfortunate autumn-hatched chick is normally exposed to the bitterest weather during rearing and subsequently either managed on range or housed intensively. Under both methods the lighting pattern during this adult stage appears to be that which, on the evidence supplied by the recent research work, is calculated to depress egg production in the late autumn. It would seem that a fully intensively-managed chick from day-old to the end of the laying cycle would prove a much more profitable venture. Failing a fully intensive régime, the departures from the customary treatment suggested above will probably help to reduce the not infrequent extreme disappointments with autumn-hatched stock, which is unjustly maligned for the owner's shortcomings.

THE MINISTRY'S PUBLICATIONS

Since the list published in the July/August 1959 number of AGRICULTURE (p. 206) the undermentioned publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops or through any bookseller at the prices quoted.

Report on Agricultural Marketing Schemes. Joint publication by the Ministry of Agriculture, Fisheries and Food, Department of Agriculture for Scotland and the Home Office.
(H.C. 234. Session 1958–59) (*New*) 5*s*. 6*d*. (5*s*. 11*d*. by post).

Domestic Food Consumption and Expenditure, 1957. Annual Report of the National Food Survey Committee. (*New*) 8*s*. 6*d*. (9*s*. by post).

Village Wheelwright

Seven years is not too long to make a wheelwright. His work is more of an art than a science: in days past he had to grow into it, and through practice and experience came to know wood and iron as friends.

Oak and ash, elm and beech, chosen from the woods and hedgerows in the summer, are the timbers with which he worked. He was content to wait until winter for his first sight of the heart of his trees under the saw. Would it dry into good timber? Six or seven years had to pass before he could be sure that he had chosen his wood well; not until then would it have seasoned and been tried by his tools.

Trade was quiet in the winter. Out of doors, wood was being sawn and stacked to season; indoors, felloe-blocks and spokes were made for future use. When the felloes came to be shaped exactly they were hard, and perhaps a little twisted in the drying. Once shaped with axe and adze, and with knowledge of where a wind-shake, for example, might be made a source of strength, they are now cut with a fine saw.

Spokes had to be of oak heartwood, for no other suitable and obtainable wood could be cleft instead of sawn—and spokes were never sawn: they might split if they were. Stocks or naves—yellow-brown hubs of elm about twelve inches across and twelve or thirteen inches long—were made when they were wanted.

Exacting demands were made on the wood of a stock. It had to withstand being pierced to receive the axle and spokes. It must not split when the spokes were battered home; or later, when the iron tyre was shrunk on.

The elegant shape of a spoke was not for appearance's sake alone. It sprang from the need to reconcile all possible strength with the lightest possible weight. But the glory of the wheelwright's craft was the farm waggon, every line of which showed how the craftsman built from tradition for strength and utility, and in so doing achieved beauty. Look at the gentle upward curve of the front and the slight narrowing of the waist. They were graceful, but they also had a practical purpose—to let the front wheels turn a little further before being checked. Why not have used smaller wheels? Because that would have brought the axle nearer to the ground, perhaps making the waggon unable to travel over heavy fields and rutted lanes. And to raise the body would have made it awkward and dangerous on uneven ground.

But as with other old rural crafts, the wheelwright's is declining. Although modern machines—lathes and the like—have eased the labour, there is no longer a demand for wooden wheels, though there are still old vehicles to be repaired. The most progressive craftsmen have developed into builders of trailers, lorries and vehicles for timber and animal transport; others have turned to such trades as estate carpentry and other types of heavy joinery. We should not regret this change: progress is a necessity, and part of nature.

A.M.R.

Photo: *John Tarlton*

Shaping the tenons of the spokes.

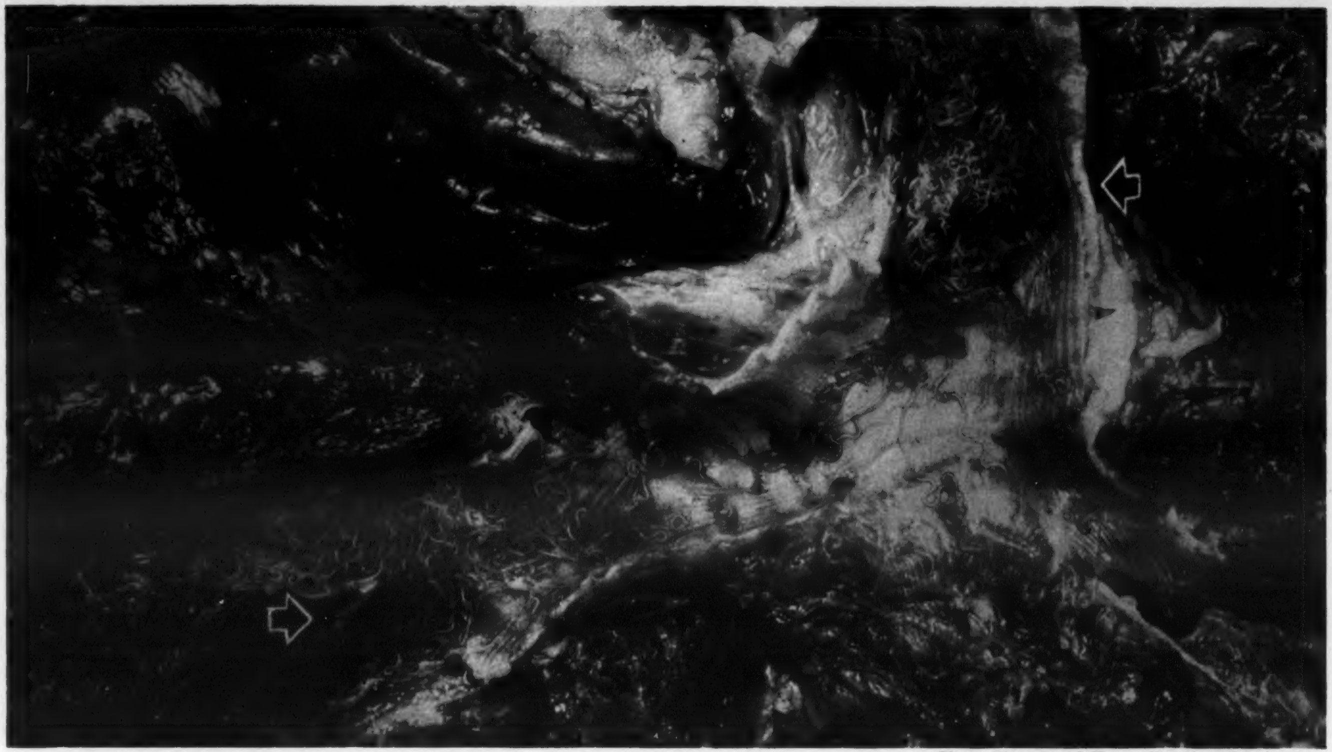

Photo: *University of Glasgow Veterinary School*

Husk—The Development of a Vaccine (Article on pp. 241–5)

A calf's lungs opened to show a heavy infestation of adult lungworms in the air passages.

Shelter for Horticultural Crops (Article on pp. 231–5)

Distortion caused by strong winds.

Photos: *Mustograph*

These poplars could make a satisfactory shelter-belt, but they are too thin at the bottom to shelter crops near the base of the trees.

Photo: *Poultry World*

Autumn-hatched Chicks (Article on pp. 236–9)

These very young North Holland Blue chicks have comfortable quarters in one section of a large, partitioned brooder house.

Husk—The Development of a Vaccine

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Extensive research work on husk in cattle, with particular emphasis on the disease process and methods of prevention, has led to a method of active immunization by an oral vaccine of irradiated larvae.

HUSK is a severe and widespread problem in this country. This is due partly to climatic factors which favour the persistence of the disease on the grass, and partly to the national tendency to stock pastures heavily, which ensures quick multiplication of parasitic diseases in general—including husk. The actual financial losses to the farming industry resulting from husk cannot accurately be estimated, but must amount to several million pounds every year.

The farmer's loss from the disease occurs in three main ways. There is firstly the obvious loss on the calves which die, and on the cost of treating the remainder. The second item arises when the calves have to come off the infected pasture; they cannot be put on to another field in case they spread the disease, so they must be brought inside. Thus not only is the utility of the grass lost, but hay and concentrates have to be used in feeding what is by now an unproductive group of young stock. This may be the most costly single factor in husk. The third and most insidious form of loss results from the after-effects of the disease. Calves may fail to do as well as they otherwise would, and often have persistent lesions of chronic pneumonia in their lungs for many months after apparent recovery.

The bovine lungworm cycle

Husk is caused by a parasite, *Dictyocaulus viviparus*, which starts life as an egg laid in one of the larger air passages (bronchi) by a female worm. It hatches almost immediately to release a minute worm approximately one-hundredth of an inch long. This larva is coughed up, swallowed, and passes unharmed through the stomachs and intestines of the calf, to be dropped on the ground, with many thousands more, in the dung. After five or six days of development, the larvae are able to infect further calves and, on being swallowed, pass once more through the stomachs. This time, on reaching the intestine, the tiny worms bore through the gut wall, penetrate a vein and are carried via the heart to be distributed all over the lungs, becoming lodged in the smallest branches of the lungs' blood vessels about a week after ingestion.

Having reached the lungs, the larvae begin to exert very harmful effects. They bore out of their confining blood vessels, penetrate the actual lung tissue and migrate through it to the bronchi, causing a reaction out of all proportion to their size, which is still very small. (Remember that this reaction is occurring many hundreds or even thousands of times in the one

These very young North Holland Blue chicks have comfortable quarters in one section of a large, partitioned brooder house.

pair of lungs.) On entering the bronchi the larvae grow rapidly, and fourteen days after reaching the lungs they may attain a length of over three inches. As more and more worms reach this situation, they partially block the air passages, thus restricting breathing, and provoking coughing by their constant irritation. The life-cycle is completed when the worms lay their eggs, from which the new generation of larvae eventually passes on to the pasture.

From start to finish, the whole process takes one month to complete, and two important points to notice are:

1. That in a matter of a few hours' grazing calves may swallow a lethal dose of infective larvae.
2. That in the first fortnight of the disease the calves may show little outward sign of the destruction proceeding within, so that apparently healthy calves taken off an infected pasture when an outbreak begins may still go down with husk up to two or three weeks later.

Dung as source of infection

The source of all infection is, of course, dung containing the infective larvae, whether it is distributed naturally by the calf or artificially by the dung-spreader, and four points should be emphasized:

1. That one dung pat may contain up to half a million larvae—and only a few thousand are required to kill a 300-lb calf.
2. That therefore three or four infected calves can effectively contaminate large areas of pasture in a week or two.
3. That under suitable weather conditions the infective larvae may remain alive and fully infective for over twelve months.
4. That the adult worms may live in the lungs of yearling cattle over the winter, thus maintaining a primary source of infection. Figures of the incidence of such carrier animals were obtained by studying 1,500 pairs of lungs from two Ayrshire knackeries during January to May, when husk is not usually found as a clinical disease. During this time, mature lungworms were found in 3 per cent of adult cows and in 33 per cent of yearlings.

Prevention by husbandry

Husk may be prevented with reasonable success by a strict grazing policy. Calves going to grass should go straight on to a fenced paddock of first-year grass, untouched by any other cattle or by farmyard manure, for the whole of their first season. The following year, they should stay on clean pasture and, ideally, a policy of segregated grazing between them and the milking herd should be followed until the older cows are eliminated from the herd. However, this policy is suitable only for self-contained herds on wholly arable farms; it may prove difficult to put into actual practice, for reasons which were well illustrated by J. F. Michel in this JOURNAL in 1957.[1]

Medicinal treatment

Because the main damage to the lungs occurs during the worms' destructive migration through the lung substance to the bronchi, it follows that to

kill only the adult worms is like shutting the stable door after the horse has gone.

Some years ago, we tried nearly twenty drugs which purported to cure the disease, but none resulted in any improvement whatsoever. Even phenothiazine is effective only at one short period in the lungworm cycle, namely when the newly-hatched larvae are passing out of the calf in the faeces. We have not tested the two most recent drugs, Helmox and Franocide, but they should indeed prove useful in actually treating the disease, if they support their manufacturers' claims.

We have been studying husk for six years, the first three of which were spent in a thorough investigation of the natural disease; the last three years have been occupied in evolving and testing various methods of protection against the lungworm, for we were convinced that it was only along the lines of prevention rather than cure that any real headway would be made.

A major factor in our favour was the knowledge that animals which had recovered from husk were usually immune to further infection. We confirmed this experimentally, and further, by taking blood from such recovered animals and injecting the serum from it into a fully susceptible group of calves, we could protect them from a normally fatal infection. Thus, not only was the formation of a solid immunity to husk confirmed, but it was shown that the protective properties could be transferred. An attempt was then made to immunize many groups of calves by injections prepared from dead adult lungworms. A range of vaccinating procedures was used, and although a degree of protection was achieved, amounting to a 50 per cent reduction in the numbers of worms found in the lungs compared with those in the uninjected control groups, this was felt to be insufficient for practical use. Moreover this method was far too expensive.

Irradiated larvae

At this point we cast widely around for a method of treating the larvae themselves, whereby we could use them in a weakened form to induce strong immunity without producing the disease. It was decided to experiment with a vaccine composed of infective larvae which had been heavily X-rayed. The first step was to find the amount of irradiation which would weaken the larvae enough to prevent their reaching the lungs, although still permitting them to pass through the gut wall to stimulate the immunity. Over-irradiation made the larvae too feeble to penetrate the bowel, and X-ray doses below the correct range failed to prevent them from migrating to the lungs.

Having settled on the irradiation level, we had to standardize the number of larvae in each vaccine dose. Too few would not provide an adequate stimulus for protection; too many merely proved wasteful. The number was finally fixed at 1,000 irradiated larvae. Calves receiving this dose, followed in six weeks by an infection with normal larvae, showed on post-mortem an average burden of ten lungworms each, while unvaccinated controls each harboured approximately 1,000 worms. Having now settled the three preliminary essentials—the irradiation level to be used, the number of larvae to be put in each dose, and the fact that this combination did stimulate an excellent immunity—we felt that the vaccine was ready for a full-scale experiment in the field. This was carried out in two parts.

Thorough testing in the field

First, we ran a trial on a three-acre paddock which was deliberately infected with enormous numbers of larvae; on to this we turned a large group of calves, only half of which had been vaccinated. Ten weeks later, 80 per cent of those vaccinated were alive and doing well, while only 17 per cent of the controls had survived. The second part of our field trial consisted of visiting forty farms in our area and vaccinating half the calves over eight weeks old in each herd, leaving the remainder to provide a control as to the state of infection on each farm; in all, we had 1,088 calves under trial. Unfortunately (from the experimental point of view!) the year (1957) was not a bad one for husk, and outbreaks arose on only six farms, which did result in 6 per cent of the vaccinated animals showing signs of infection, compared with 62 per cent of the controls.

In the winter of 1957–58, we performed a trial on fifty calves, to determine whether two doses of vaccine were better than one. Thirty of the calves were vaccinated twice, six weeks apart, ten received one dose only, and ten were left unprotected. We challenged the calves on this experiment with heavy doses of infective larvae, and when we killed them and examined the lungs, it was evident that two doses of vaccine were considerably superior to one. We also found that no advantage resulted from making the second dose larger than the first.

The results from this trial were applied to our 1958 field experiments, in which we twice dosed all the calves on each of over 200 farms—a total of nearly 8,000 animals. Our object was to test husk vaccination very thoroughly under normal practical conditions, and to investigate any breakdowns, should they occur. We did visit several farms where the immunity had apparently broken, and found that one of three things had actually happened:

1. The calves were grazing infected pasture either before or very shortly after their first dose.
2. They had been treated with phenothiazine on the day of vaccination—thus killing most of the vaccine!
3. Immunity had in fact been overwhelmed by freak, massive intakes of about half a million larvae.

Correct use

The husk vaccine, which is incidentally the first parasitic vaccine in the world, could go a long way towards complete elimination of the disease from this country, if used correctly and on a wide enough scale. "Correct use" implies that calves to be vaccinated must be at least eight weeks old, since earlier than this, they are incapable of reacting to the vaccine by producing an immunity; that such calves must not have had any contact with husk before the completion of their vaccine course, as the vaccine is a preventive, *not* a treatment; and that the calves be kept away from any source of husk infection for a further four weeks after their second dose, to enable their immunity to become solidly established. However, this four-week period may be shortened at the discretion of the veterinary surgeon in the light of his local knowledge of the prevalence and severity of husk.

Further projects

The principle of irradiating the infective larvae of a parasite to weaken it sufficiently for purposes of vaccine production can be applied to other parasitic worms. We have recently demonstrated it successfully in the case of one of the stomach-worms of sheep, and are at present working on vaccines against ten more parasites, including the liver fluke.

Although our work at present is, of course, entirely veterinary, it is a matter of some speculation among us as to what might be achieved in the human field, especially in countries whose economic structure is disrupted by parasitism, if vaccines against the comparatively few major parasites of man could be developed successfully.

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Spaced Seeding of Swedes

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Following the lead given by sugar beet cultivation, the precision drilling of swedes shows a substantial saving in labour.

THE early work on swedes, by Whitehead at Bangor in 1933–34, showed that close spacing of plants increased fresh weight yield as well as the feeding value of individual roots.[1] His experiments were carried out under the orthodox method of sowing and he concluded that "the only disadvantage incurred by closer spacing would seem to be the extra cost of singling . . . it is only one amongst many factors which affect the cost of production of the swede crop, and . . . the trials show a considerable balance in favour of singling the root crop closer than is at present customary". The other factors referred to were the several diseases that can beset the swede, and close spacing seemed to reduce the incidence of some of these. Today, however, fungicidal seed dressings are available to control many of the diseases which were considered serious twenty-five years ago.

The disadvantage of extra singling costs is now eliminated by the new method of seeding which is becoming popular in many areas. Moreover,

because a closer spacing of roots will not reduce the crop yield, a particular impetus is given to a reconsideration of the root crop on farms where its heavy seasonal labour requirements have hitherto ruled it out. Labour can now take a minor role in the cultivation of fodder roots and this means, of course, a substantial lowering of cost.

Development of the precision drill

With the development of precision seeders, the complete mechanization of the crop is now a reality and consequently less labour is required. The initial success in sowing single seeds was achieved with sugar beet, and it is this crop which has given the sharpest spur to the development of new root-drill mechanisms. Other crops such as swedes, turnips and kale are now benefiting from the attention given to sugar beet.

Modern precision drills are carefully designed, and considerable improvement in seed delivery over the old cup-and-brush feed drills is the result. Manufacturers seem to favour the production of separate drill units each with its own sowing mechanism. The advantages[2] given by this system are:

(a) flexibility—one or more units can be used, at any width setting, on the ridge or on the flat;

(b) economy—the tool-bars on which they are mounted can be used for other work;

(c) precision—because the drills are normally close to the ground a short seed fall helps even spacing.

The braird consists of single plants which will not grow into the tangled mass that results from the usual method of sowing when singling is delayed. Thin, regularly-spaced plants make subsequent operations easier than with an overcrowded population. Narrow brairds will allow effective mechanical inter-row hoeing to proceed as soon as weeds begin to appear, as the discs or blades of the machine can be set to cut close to the plants.

Preparation of the land

Good cultivations are vital to secure the best possible seedbed conditions, which are so necessary to guarantee the survival of each single-sown seedling. Autumn ploughing to expose the soil to the weathering influence of hard frost cannot be equalled for the production of first-class tilth in the seedbed. In the higher rainfall areas, the traditional practice is to skim-plough the stubble 3–4 inches deep in the autumn, and follow with cultivating operations to encourage weed seeds to germinate. Utility ploughing should succeed the harrowing on heavier soils, whilst digger ploughing is more effective on light fields. This essential difference within the practice of autumn ploughing is based on the fact that a crested furrow allows more exposure of soil to frost and, in the case of medium to heavy soils, a frost mould is always the best tilth. On light land a completely upturned furrow gives a better cultural control of weed.

As swedes are sown comparatively late, the period for spring cultivation is much longer than for other rotation crops. Cultivations on the heavier soils must be shallow to avoid bringing to the surface raw soil, with its

content of viable weed seed. They may be carried out satisfactorily with spring-tined cultivators and harrows, but other cultivators may also be suitably adapted to stir the shallow tilth. On light land a second ploughing is customary, and this ensures good elimination of weed as well as providing an excellent tilth for timely sowing.

In areas of higher rainfall the land is ridged up for sowing. This allows better drainage of surplus water, and the soil warms up much more quickly. Ridges are an advantage for inter-row cultivations on sloping fields, and stones present a much smaller obstacle to seeding. The value of ridge sowing is particularly appreciated when crops are grazed off in the field; the roots are not as deeply set in the soil as with flat drilling, and this keeps the eaten surfaces washed free of soil throughout the period of grazing.

Drilling on the flat is generally practised on heavier soils in the drier areas, where it is so important not to disturb the frost mould. It is also more appropriate on very light soils where a minimum surface area is essential to avoid excessive drying out of the land.

Seed and sowing

Precision drilling is the sowing of single seeds at predetermined distances in the row and, for vigorous germination of the seed and strong healthy growth of the plant, it is essential that seed from only the best stocks is used. Root seed specialists are particularly aware of this basic need, and specially prepared material for the precision drill is available on the market. Single seeds are dropped through the seeding holes of the drill and for maximum drilling efficiency it is imperative that the seed used is very even in size. Stocks are therefore graded to meet exacting requirements of machines, and seedsmen collaborate closely with manufacturers.

It is of paramount importance that the seed should also be protected from the pests and diseases which beset it during its early stage of growth. Dual-purpose seed dressings containing *gamma*-BHC—to control flea beetle attacks up to crop emergence and beyond—and thiram, to protect the seed against soil-borne fungal attacks, are recommended. Each seed must carry its own load of protective material and, even after dressing, a close watch must be kept on the seedlings in case subsequent dusting or spraying against pests is needed.

The seeding rate per acre usually varies between ½ and ¾ lb for precision drilling, the quantity used depending on the size of seed and the space setting of the drill. Seeder units are independently mounted on the tractor tool-bar, and a recent development for ridge sowing is the provision of a fore-moulded roller to run over each ridge to steady the machine. Under near-ideal conditions for sowing, a space setting of 5–6 inches, which means that plants will appear 7–8 inches apart, is recommended. Where the tilth is not so good, and in the drier areas, a safer setting is 1–2 inches, when plants will appear at 3–4 inches apart and will require hand or mechanical thinning.

Singling and cleaning

With the traditional method of sowing, when 3–4 lb of seed is drilled per acre, it is customary to single the plants to 9 inches apart, but this operation

is unnecessary nowadays where the seedlings have been precision seeded at 7–8 inches apart.

It is wise to drill for 3–4-inch spacings in the lower rainfall areas, as well as in the higher rainfall districts where tilth conditions, or an anticipation of a heavy weed infestation, give cause for anxiety. Weeds between the plants can now be removed by mechanical means. The gapping machine, which is a fairly well-known implement, is power operated and works well on ridged crops, whilst the simplified down-the-row thinner, in which the cutaway mechanism is geared to the forward movement of the machine, is more appropriate for crops sown on the flat.[3]

Control of weeds by sprays is developing well. Experimental work in Wales over three seasons shows that spraying with PCP at 1½–2 lb acid equivalent per acre gives yields as good as those obtained by orthodox cultivations. The use of PCP is also being adopted by farmers themselves on a field scale. Two techniques of application are practised: drilling in the weedy seedbed followed by spraying soon afterwards, or spraying it first and drilling a day or so later. The latter practice is preferable because no obstacle to the efficient operation of the drill is created by the disintegrating leaves and stems of the weeds.

Effect of spacing on yield

The best test of a new technique in crop growing is output per acre. The work of Maddox[4] in the north of Scotland showed very similar yields in turnips between crops sown at close spacing and singled to the normal distance, and crops sown at a 6-inch drill setting and unsingled. Experiments in Wales with swedes have followed the same pattern, and figures for four experiments over two seasons are given below. The yields are expressed in tons per acre at 90 per cent dry matter, which means that the fresh weight would be approximately ten times as much.

Mean yields (90 per cent dry matter)

Treatment	Brecon 1957	Brecon 1958	Radnor 1958	Monmouth 1958	Mean
			tons per acre		
Farmer's drill (singled)	2·34[5]	2·22	1·42	2·12	2·02
Precision drill 1-inch setting (singled)	2·26	2·08	1·40	2·16	1·97
Precision drill 5- or 6-inch setting (not singled)	2·38	1·98	1·26	1·94	1·89
Standard error	±0·08	±0·12	±0·11	±0·11	

Plant population per centre

Treatment	Brecon 1957	Brecon 1958	Radnor 1958	Monmouth 1958	Mean
			Number of roots (*thousands per acre*) Centre		
Farmer's drill (singled)	25·4	21·2	26·6	25·6	24·7
Precision drill: 1-inch setting (singled)	25·4	25·2	23·7	25·2	24·8
Precision drill: 5- or 6-inch setting (not singled)	20·6	17·1	21·3	22·4	20·3

The yield determinations show that the different treatments produce the same yield of swedes per acre. This has been achieved despite a lower plant population per acre in the unsingled precision drilled treatments.

The plant population figures given above are of interest and show that root size was undoubtedly larger in the unsingled crops—precision drilled at the 5- or 6-inch settings for the drill—than in the crops sown and singled in the traditional way.

The adoption of the spaced-seeding technique in swede crops also results in a considerable saving in labour costs. Hand-hoeing and singling costs, on average, £8 an acre,[6] but these operations may be unnecessary when the technique of precision drilling is well understood. Culpin[7] assesses the total annual charge for the smaller farm on a £100 drill to be £12 10*s.* (that is, depreciation, interest on capital, storage and general maintenance). This means that where about 1½ acres are grown each year, the saving in labour costs just about equals the annual cost; the savings in the labour bill in respect of root work for more than 1½ acres would therefore directly offset part of the initial outlay of buying the drill. Where a crop is precision drilled at 2–3-inch spacing, the cost of singling and hand-hoeing is about £2 10*s.* an acre. This gives a saving in labour costs of £5 10*s.* an acre per year, and means that where a drill is used to sow two acres only in any one year, the saving in costs just about covers the annual charge.

Besides the direct saving in labour costs which arises from the use of a purchased or hired drill, peak seasonal demands on labour for singling and cleaning are also avoided. This allows urgent farm operations such as hay-making and shearing, which would normally clash with root work, to proceed unhindered.

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★ NEXT MONTH ★

Some articles of outstanding interest

FARMERS' MACHINERY SYNDICATES *by A. R. L. Aylward*

BRITISH SEEDS INDUSTRY *by Henry Burtt*

COLD STORES FOR FRUIT AND VEGETABLES *by G. Mann*

RASPBERRY RESEARCH *by C. A. Wood*

Drayton

STANLEY CULPIN, M.SC.
Farm Director

THE 450-acre Manor Farm at Drayton borders the south side of the main road from Stratford-on-Avon to Alcester and Worcester for about a mile. Much of the farm is in full view of the highway, and during the last hundred years travellers have seen many changes in the standard as well as the style of farming. In the golden age of the ninteenth century, much of Drayton was intensively cropped with wheat, beans and clover, but the economic conditions of the late 1870s caused the occupier to leave the farm in 1879 and it remained without a tenant for the next thirty-five years. During that time it became a scene of dereliction: bramble, thorn and ash multiplied, and there was a complete reversion to scrub and woodland conditions. In 1914, necessity brought the farm back into cultivation, and good corn crops were grown from 1915 to 1920. Unfortunately, this proved to be only a brief respite. History repeated itself when economic conditions deteriorated, and the tenant left in 1926. By 1940 the farm was once again completely derelict.

This is not an uncommon story for a Lower Lias clayland farm. In a favourable season cultivations can be done with reasonable economy, but plans must always be ready for the wet one, when an extra six inches of rainfall above the usual twenty-four can easily double the amount of work to be done. Whether the power is provided by horses or crawler tractors, it is necessary to carry a reserve to work the arable land adequately in the short periods available; and this is expensive. The Drayton soil varies in depth and drainage properties, but all of it is of heavy clay texture. It contains abundant free lime and, although extremely sticky when wet, has the virtue of breaking down to a mellow tilth when exposed to suitable weathering conditions. Drainage properties vary from field to field according to the lie of the land, the presence or absence of springs, the depth of geological drift material, which covers about half the area, and the presence of horizontally-bedded limestone, which occurs from about six inches downwards on several fields. This helps to lead water to the ditches, but can cause havoc with cultivation implements. Thorough pipe drainage has not been practised on the farm this century, but wet patches have been tapped, with varying success, and certain fields have been mole drained.

The present phase in the history of Drayton as an experimental centre may be regarded as beginning in 1940, when the Ministry of Agriculture and Fisheries took possession and the farm became well known as the Grassland Improvement Station. From then until 1944 the emphasis was on food production, and the study of urgent grassland problems connected with the food production campaign. After 1945, grassland problems of a fundamental nature became more prominent, and later the Grassland Improvement Station was incorporated in the Grassland Research Station, operating under

the Agricultural Research Council. The Grassland Research Institute vacated the farm in October 1955, and the property then took on its present role as an Experimental Husbandry Farm with an interest in all suitable agricultural crops and stock, instead of concentrating on grassland problems alone.

Farm buildings

By 1955 the farm buildings consisted of a mixture of ancient stone barns, stables and byres and recent Dutch barns. The former are difficult to use effectively in modern times, and are a liability for repair work, whereas the latter provide useful covered space for a variety of purposes.

Drayton is being specially developed to undertake detailed studies of different ways of conserving grass. One of the barns at the main premises has been adapted to house a two-bay barn hay drier and a grain drier complete with storage for 200 tons of grain. One of the hay bays is heated electrically, and has sufficient power behind the fans to adopt the "cold-blow/hot-blow" method. The other is heated with an oil-fired heat-exchanger which also provides warm air for the grain drier. Under another barn, in the middle of the farm, a group of four silos has been built in which critical experimental work on silage-making can be conducted. One new building has been added: a covered bullock-yard capable of holding about 100 animals, in which it is intended to carry out winter feeding experiments, particularly with relation to the use of conserved grassland products.

Livestock and rotations

It was decided at an early stage that cattle feeding and fat lamb production from a grassland flock should be the main livestock enterprises, and that experimental work should be concentrated on the problems of these two. Most of the cattle are bought as weaned calves at the autumn sales organized in the Welsh Border markets. Sired by good Hereford bulls, and chiefly out of Hereford-cross cows, they provide uniform animals for experimental purposes. The average number carried is about 150. Lambs are bought every year to replenish the flock of 250 Scotch Half-bred ewes, and the ewes are drafted out before their useful breeding life has finished.

The farm has been arranged in seven approximately equal blocks of land, and within these blocks the farming rotation is adapted to experimental needs. If a long ley is required, the rotation may be five years grass followed by two years of corn, and the second seven-year period will probably be split up to include short (one- or two-year) leys, a larger proportion of corn crops and field beans. Rather more than one-third of the farm carries cereals and beans, and rather less than two-thirds carries leys. The emphasis is on autumn sowing of cereals, but spring sowing occurs often enough for the undersowing of the longer leys.

Trials with cereals and beans

A considerable area is devoted each year to annual trials with cereals. The nitrogenous manuring of winter wheat has been the subject of many previous

experiments, but it has been suggested that the case for autumn nitrogen is altered by the widespread adoption of modern stiff-strawed varieties such as Cappelle Desprez. This variety is therefore being grown with seedbed and spring nitrogen at various levels. Spring wheat has shown a profitable response to 3 cwt per acre sulphate of ammonia broadcast on the seedbed, but it is questionable whether this is a sound reason for the increasingly common practice of combine drilling granular fertilizer containing the equivalent quantity of nitrogen with phosphate and potash. In a dry season, there may be an unduly high concentration of salts around the germinating seed, and a trial has been started this year to see whether such factors influence the final yield. Work on variety testing is never finished.

Field beans are notoriously unreliable and variable in yield from year to year. They give very little response to fertilizers unless grown on land deficient in one or other of the common plant foods, and in the case of winter beans the best time to drill is influenced more by what the weather may do after drilling rather than by what it has done before. To drill too early is inviting frost damage, and to drill too late is asking for the crop to be eaten by birds and other vermin, or rot in the ground. On the other hand, current trials show that choice of variety is important. The control of black aphids on spring beans by spraying can help the crop materially and, although some plants will normally be self-pollinated, the exclusion of bees at flowering-time can halve the yield. It is most unlikely that beans will ever be as easy to grow as cereals, but these and other subjects are being studied in an effort to improve the prospects.

Long-term experiments are, in the main, a combination of crop and animal husbandry. For example, silage and hay are only intermediate steps in the process of producing beef or fat lamb from grassland, and the ultimate object is to relate the output of the soil to the production of meat.

Grass conservation

Barn hay drying studies were undertaken in 1958 for the first time, and about 75 tons of good hay was produced without undue difficulty. The method is to cut and reduce to 50 per cent moisture content or less as quickly as possible; then to make half-size rectangular bales with the pick-up baler, and cart them immediately to the drier where they are packed on edge to a maximum depth of six layers or about nine feet. Greater depths have not been wholly successful, and moisture contents in excess of 50 per cent have been extravagant of time and fuel.

Last year it was found that, owing to reduction of field losses, the yield per acre of barn hay was considerably above that of ordinary hay cut on the same day. Although the weather probably exaggerated the effect, it is obvious that this will be a general tendency, so that extra quantity as well as extra quality can be set against the expenditure on fuel and overheads which are inescapable in barn hay drying. Whilst carrying out experiments on barn hay drying, we have been able to use an oil-fired heat-exchanger designed by the National Institute of Agricultural Engineering, and provide the Institute with useful information about their machine under practical conditions. Thus our barn hay drying consists of a field experiment and a drying experiment. The story will not be complete until it also includes a feeding experi-

ment in the newly-completed bullock-yard. The long-term object is to determine the most economical method of hay production, and the relationship between cost and quality as measured by the animal.

Silage-making studies began in 1957. The four silos have been so designed that a finished depth of six feet can be achieved with a total quantity of 40–50 tons of silage per silo. Every load of herbage ensiled, and every load of silage taken from the silos, is weighed and sampled so that an accurate balance sheet of processing losses can be compiled. Various measuring devices also keep a check on the amount of liquid effluent from the silos, and on the temperature changes which occur through the mass of material. From comparisons of ensiling fresh and wilted grass/clover mixtures, it is evident that fermentation losses within the silo are reduced by wilting before ensiling, but by comparing the quantity of crop collected from equivalent areas it is equally clear that field wilting can cause a considerable reduction of dry matter collected per acre. This method of quantitative as well as qualitative assessment is being continued, and the effects of modern silage-making machinery will be taken into account.

Grazing experiments

Grazing and allied experiments include comparisons of cattle grazed alone with cattle and sheep grazed together, various methods of grazing management for lamb production, and a comparison of the productivity of land according to whether bullocks being supported by it are wintered indoors or grazed for as long as possible during the winter on cocksfoot/lucerne rows. This last-named trial must not be judged before completion, but it is fair to say that in the last two winters the progress of winter-grazed cattle has been disappointing, and the trouble of looking after them out of doors has been considerable. Among the difficulties encountered have been wet weather, with consequent poaching and discomfort of the bullocks, indigestibility of the cocksfoot, and the refusal of determined animals to be checked by electric fencing.

In the mixed stocking experiment, it is possible to measure the influence of sheep on cattle and vice versa. The results so far have supported the belief that sheep are well able to find a living in competition with cattle, but cattle suffer very quickly from the competition of a ewe and a pair of lambs per acre.

Obviously an experimental programme of only three years' duration cannot yet have produced many definite results, but it is gratifying that visiting farmers, who come in increasing numbers each year, are finding more and more information of value to them as time goes on. The Farm Advisory Committee, presided over by Mr. Maurice Passmore, also give much encouragement as well as unstinted help to the farm director and his colleagues, and can be relied on to guide future work along practical and useful lines.

Championship Barley

George Jarrett
Clevedon, Somerset

Close attention to soil fertility has helped a small, mixed farm near Porlock to bring two coveted trophies to a corner of west Somerset long noted for its excellent barley.

The harvest of 1958 will long be remembered on Bossington Farm, Porlock, but for a happier reason than on many farms. Mrs. A. G. Rawle, the farm's tenant, scored a double success in barley competitions. Last autumn she won the Championship cup presented by the Directors of the Brewers Exhibition, and now she has won the Farmers Weekly Malting Barley Championship. What lies behind these successes?

Bossington is a farm of about 110 acres devoted to corn, sheep and dairying. Mrs. Rawle, who runs it with the help of her daughter Mrs. Morgan and grandson Mr. Tony Morgan, was very proud to tell me that fifty years ago her husband won the National Malting Barley Competition, and that the same championship had been won by the farm's barley just a few years before he took over the holding.

It is a real family farm, with true family pride in its achievements and in those of the surrounding Vale of Porlock: Mrs. Rawle was influenced to compete by the thought that she wanted to see the Vale listed among the cup winners. Her success, she claims modestly, was due to a large element of luck with a little bit of good barley to help things along. But luck can be just a matter of knowing one's job: the Rawle family deserve these successes.

Last year, twenty-two acres of barley were grown, as well as some oats. The barley is now all Proctor in place of the former favourite, Plumage Archer; the winning sample came from a four-acre field, after kale which had been strip grazed by cattle. The stone brash soil with its gravel subsoil is easily drained. "We try to plough every field about seven inches deep", said Mr. Tony Morgan—which seems to refute the idea that shallow ploughing for barley and after sheep folding is the right method. The seed rate for the winning crop was 2½ bushels an acre; the field was drilled about the end of March, and 3 cwt per acre of a fertilizer containing 9 per cent nitrogen, 6 per cent phosphoric acid and 18 per cent potash was broadcast on the seedbed. The crop was combined on 30th August, and 35 cwt per acre was harvested. And this was in a bad harvesting year. If the whole crop had been saved, the yield would have been more.

Fertilizers, sheep folding and leys

On Bossington Farm the spirit of doing one's duty by the land, of farming for tomorrow rather than for today, is quickly apparent. Sheep folding and the judicious use of fertilizers play a great part. Mrs. Rawle aims at maintaining fertility: the soil needs potash, and this is always borne in mind

when planning the fertilizer programme. Last year's fertilizer was chosen in place of the usual one because of its slightly higher potash content—18 per cent against 15. It is possible that here lies the key to success—just that little bit of extra potash. Of course, no one can really say, any more than one can try to assess the value of the salt-laden winds which sweep across the farm.

I have already mentioned Mrs. Rawle's use of sheep folding as a means of maintaining fertility. An interesting aspect of this part of the farming is that none of the sheep belongs to the farm. Some 300 hoggs are taken into keep during the winter, being folded on roots, grass, some sixteen acres of swedes and kale and about six acres of turnips. Last year's championship field was tilled to oats and vetches after the barley had been harvested, to be strip grazed and then to come into roots for the sheep next winter. The herd of twelve or fourteen Shorthorn and Devon cows, with forty followers, also make their appropriate contributions to fertility and income.

Asked about not owning any sheep, Mrs. Rawle explained that under this system all she has to do is to ring up the farmer taking the keep and the sheep come along. She has no suitable summering ground; when the spring keep has gone, she telephones again and they are taken away. She has no worries trying to maintain a flock when keep is short, or with lambing. This system would not suit everyone, but it has its merits. It helps farmers above Porlock, whose policy is to send sheep away to more sheltered conditions during the winter, and in so doing it enables farmers like Mrs. Rawle to fold down their arable crops, get an income from the keep and build up fertility at the same time.

Although no fixed rotation is followed, a policy of three-year leys ensures that fertility is maintained, humus content looked after and no risk of over-cropping entailed. Timothy/meadow fescue leys are sown down after harvest. Cocksfoot leys are not popular at Bossington, although I should have thought they would have been ideal for building up humus on these stone brash soils.

Bossington Farm is delightfully quiet during the winter but almost overrun with visitors during the summer. The farm forms part of the National Trust but, regrettably, holiday-makers seldom seem to understand that a farm is a place of work.

Mrs. Rawle originally came from North Devon, and is one of those people to whom farming and the land are their whole life. Bossington is a tidy, well-kept farm reflecting the care, one may almost say affection, that is bestowed upon it. Mrs. Rawle is a good farmer and a good tenant, and also the first to acknowledge her debt to her daughter, her grandson and the small staff who help to run the farm. Let us hope that "a little bit of luck, a little bit of potash and a little bit of salt from the sea" will long continue to exercise a beneficial influence in this little corner of west Somerset.

Farming Cameo: Series 2

17. Colchester District

H. J. MASON, B.SC.
District Advisory Officer

COLCHESTER, with its weekly stock market and corn exchange, is the centre of a district covering some 120,000 acres of north-east Essex, bounded on the north by the River Stour and its estuary, and to the east and south-east by the North Sea. The western boundary is not well defined, but follows approximately a line drawn from the ancient smuggling village of Virley in the south to Bures in the north.

There are records of a settlement on the same site 2,400 years ago. *Camulodunum*, as it was called at the beginning of the first century A.D., was occupied by the Romans soon after the invasion of A.D. 43, and the castle museum now contains a very fine collection of Roman remains, most of which have been found locally. The river Colne enables sea-going ships to reach the port of Colchester, from which considerable quantities of farm produce were once exported to the London area. The Colne oyster fisheries, owned by the Colchester Corporation for centuries, yield the "Colchester Native", and an annual Oyster Feast is held in the town. Other towns, which include Clacton-on-Sea, Walton-on-the-Naze, and Frinton-on-Sea are mainly important as holiday resorts.

Highly mechanized arable crop production is the most important feature of the agriculture of the district. Some 80 per cent of the land is in either arable crops or temporary leys. Of the remaining 20 per cent, considerable areas are low-lying coastal marshes, which remain permanent pasture only because of the difficulty of providing adequate drainage for arable cultivation.

The soils, which are all of geologically recent origin, vary from very light sand and gravels to loams, heavier boulder clays, and the very heavy London Clay. Sand and gravels are found mainly for a few miles to the south of Colchester and on both sides of the river Colne. In many places the large deposits are being worked, and the gravel transported by barge to London.

Naturally acid and deficient in potash, these soils are "hungry", and need regular chalking and fertilizing to give the best crops. They are easy to work, although their stony nature results in rapid wear of implements.

The natural tendency of this type of soil to suffer from drought is exaggerated by the very low rainfall of the area. The principal crops are early vegetables and early potatoes, which can be marketed before the summer water shortage becomes severe. In an attempt to widen the range of crops which can be grown successfully, many farmers are now using irrigation, taking the water from the gravel pits.

To the east of Colchester, an expanse of loamy soils forms the central area of the Tendring Hundred, which is well known for its high standard of arable farming. From these light, fine, sandy loams, very good crops of

corn, potatoes and sugar beet are produced. A feature of the area is the winter barley. In recent years the variety most widely grown has been Proctor; in most years it survives the winter well and will produce a heavy crop which, mellowed by the sea breezes, is of first-class malting quality. Pioneer, which is the only true winter barley, is used to a very limited extent.

Early potatoes for lifting in early June are widely grown. Popular varieties are Ulster Chieftain, Ulster Premier, Arran Pilot and Craig's Royal. Many farmers have recently started using fluorescent lights in converted buildings for chitting the seed. For the ware crop most of the seed is once-grown from Scotch or Irish certified seed.

In the south of the district is an area of heavy soils derived from the London Clay. Much of this land tumbled down to grass in the 1930s. The main problem in producing arable crops is the poor natural drainage, but very considerable areas have now been drained by putting in tile mains, and moling over them. This land requires heavy machines for ploughing and cultivating; many farmers have crawler tractors. It is difficult to cultivate in the autumn, and in the recent wet years slug damage to the winter wheat has been severe on the cloddy seedbeds. The best seedbeds are obtained in the spring, from the fine crumb resulting from early autumn ploughing and winter frosts. The main crops are winter wheat, red clover and peas. Very few roots are grown.

The boulder clay west of Colchester is used for the production of both flower and vegetable seed crops, in addition to corn and roots. Peas for picking are a feature of this area. For early production, British Lion are usually winter sown, but the more recently introduced Feltham First is now grown extensively. The peas are picked by Romanies, who come into the district especially for this work. In early June their caravans and tents occupy the roadside verges, lanes, and small fields where farmers permit camping. After the peas have been harvested, they leave and are not seen again until the following June.

Along most of the sea coast are stretches of marshes which, as they are below the level of high tide, are protected from the sea by clay walls faced on the seaward side with concrete blocks. During the disastrous floods in 1953, some 8,000 acres in the district were flooded. To restore this land to full production, large quantities of gypsum were applied and very extensive drainage work carried out.

Although most of the land is arable, livestock are also of considerable importance. Traditionally, stores were bought in the autumn, to be fattened on roots in yards during the winter. This practice has declined, and has been replaced on some farms by a dairy herd and on others by rearing calves, which are often kept to be fattened on silage in the winter. Sheep numbers are increasing. Most of the sheep are now grass flocks and only the few notable flocks of Suffolks, mainly concerned with the production of ram lambs, are still folded.

Glasshouse Statistics
England and Wales

CROPS GROWN IN GLASSHOUSES (July 1959)*

	Jan. 1958 *acres*	Jan. 1959 *acres*
Total Area of Glasshouses		
With heating apparatus	3,265	3,196
Without heating apparatus	658	685
Total	3,923	3,881
Crops in Glasshouses at 15th January		
Lettuce	453	440
French beans	2	2
Mushrooms	37	36
Tomato and cucumber seedlings	180	173
Other vegetables and herbs	55	47
Carnations	174	177
Roses	123(a)	122
Orchids	6	6
Bulbs for forcing	160	166
All other flower and foliage crops	364	352
All other crops not specified above	135	122
Total	1,689	1,643
Remaining glasshouse area (being the area unused at 15th January or used for other purposes not shown above	2,234	2,238
Total area of glasshouses	3,923	3,881
Chrysanthemums in Glasshouses		
Area of chrysanthemums grown in autumn and winter	690	694
Lettuce in Glasshouses		
Area of lettuce completely cleared before 15th January	52	35
Area of lettuce as at 15th January	453	440
Area of lettuce to be planted between 16th January and 31st March	281	293
Bulb Flowers in Glasshouses		
Total number of flower bulbs forced, or to be forced under glass during the winter season	195,447,000	217,984,000

* Includes Dutch light structures which were glazed at the census date.

Note: The January 1959 census was limited to occupiers of holdings with more than one acre of land used for agriculture, and with not less than 1,000 square feet of glass. The figures for January 1958, when returns were obtained from all holdings with not less than 1,000 square feet of glass, have therefore had to be adjusted for the purpose of comparison with January 1959.

(a) Revised figure.

In Brief

DOCKS IN GRASSLAND

N.A.A.S. studies in Devon during the past eighteen months have shown that planned rotary cultivations can give good control of established docks in grassland. Five rotovations are usually required for a complete kill. The cost will be between £5 and £9 an acre, depending on whether the farmer owns a machine or has to employ a contractor. The expense of the normal cultivations to prepare a seedbed can be deducted from this, because after the fifth rotovation the soil is usually ready for a crop.

Don't plough; the work is best done on hard ground, which will hold the docks firmly and give a better chance of chipping pieces off their roots. Rotovate only half-an-inch deep with the tractor in low gear. The docks will then draw on their reserves to produce new leaves, and will go on "living on their fat" until these leaves are two inches long. At this stage, rotovate again one inch deeper, at 1½ inches. Let the docks put out more new leaves two inches long, then rotovate a third time, to a depth of 2½ inches. After further new growth, rotovate at 3½ inches. Any subsequent rotovation which may be needed should be 5–6 inches deep.

Italian ryegrass may usefully follow the treatment. It can be sprayed with MCPA or 2,4-D if necessary, to destroy any seedling docks and prevent seeds from germinating.

Treating the docks at the right stage of regrowth may mean rotovating when the soil is too wet for normal seedbed preparation. The farmer must use his own discretion about this.

To prevent the seedbed from becoming too fine, keep the flap of the rotovator raised, unless the dock leaves are not being torn off, in which case put the flap down. If the rotary cultivator has several gears, always use the highest speed for the rotor blades.

In dry conditions the docks may be adequately lacerated with the tractor in second gear, and the job will be done quicker and cheaper. But if the dock leaves are not being torn off or the roots not being cut through properly, first gear should be used.

After the fourth rotovation it may be possible (and cheaper) to use discs, set deeply, instead of the rotovator, especially in dry weather.

April–June appears to be the best time of year for this job, but work has been done at other times with promising results. On heavy soils, winter work would be out of the question. The aim of the operation (to exhaust the docks by repeatedly destroying their foliage and compelling them to use their food reserves) should always be borne in mind.

This technique is still in the experimental stage, and control cannot be guaranteed under all conditions. But if these suggestions are carried out carefully, good control should result in most circumstances.

PROGRESS OF THE SMALL FARMER SCHEME

Up to the middle of July, 18,938 applications under the Small Farmer Scheme were received from farmers in England and Wales. A total of 10,908 farmers have subsequently submitted farm business plans, and of these 6,880 have so far been approved. The average amount of grant involved in plans approved up to the end of June was £692.

In addition, 2,018 applications under the Supplementary Scheme were received up to the same date, and of these 1,529 have been approved.

FRESH-FROZEN MILK: A NEW BRITISH EXPORT

Fresh British dairy milk—treated with sound waves and then frozen solid—is to be marketed throughout the world.

Sponsored by the National Research Development Corporation, backers of Britain's Hovercraft, the project will enable British farmers to sell any surplus milk in the higher range of manufacturing prices. This could absorb economically any surpluses that might occur, as well as giving a higher return to the farmer.

The process will keep milk fresh-frozen for eighteen months provided the temperature of the milk itself is kept below 8°F; this enables it to be shipped anywhere—particularly to tropical countries where fresh milk supplies are not normally available.

Dairy laboratories in many countries have been experimenting to preserve milk for long periods. The new British process is the first to achieve complete success. When this milk is thawed out (unlike the currently available frozen homogenized milk) it returns to a completely natural state without any alteration in condition or taste.

The process was evolved by Dr. W. G. Wearmouth at the National Institute for Research in Dairying, and the invention is now under the control of the N.R.D.C., which holds patents at home and abroad covering the technique. A major British ice-cream manufacturing company has been granted a licence to produce the frozen milk, which is already being made in small quantities. Full-scale production will start later this year.

The process, after normal pasteurization, consists of treating the milk with ultrasonic vibrations of about a million cycles per second for five minutes, and pouring it into containers for quick freezing. The process is continuous and there is no delay between the different operations. The milk can be transported in containers of up to one gallon capacity in refrigerated ships, trains or lorries and is also sold in liquid-proof cartons down to half-pint size.

OUR DAIRY INDUSTRY

Speaking to delegates to the Dairy Festival in London on July 20th, the Minister of Agriculture pointed to the importance of the dairy industry in this country. Occupying the premier position in our agriculture, milk production, he said, represents to the farmer an income of something near £350 million—nearly a quarter of the total farm income. "Each day," said Mr. Hare, "four million gallons of milk are drawn from three million cows. This is collected, processed, bottled by most hygienic methods and delivered in 25 million bottles on nearly every doorstep in the country without a drop being wasted. These are really impressive figures. I reckon that if all the milk produced in England and Wales in one day were to be poured into the court of Trafalgar Square, it would reach half way up Nelson's Column. That gives some idea of the quantity of milk that we produce in this country each day.

"So important do we in the Government believe that milk is to people that we willingly back the joint efforts of the distributors and the producers in encouraging people to drink more. Last year, for instance, we drank 14 million more gallons of milk than we did in the previous year. And the demand is still increasing. Sales this June were 1¼ million gallons up on last June. Sales of cream too have gone up astronomically. Last year they were the highest since before the war—only 100,000 gallons below the all-time record in June 1939. Last month nearly seven million gallons of milk were sold for cream—the exact figure is 6,710,000 gallons. This is over two million gallons more than was sold last June.

"The same success story is true of cheese. In 1955 the National Milk Publicity Council introduced a campaign to bring the qualities of our very fine cheeses to the notice of the public. I am glad to say that more than half the quantity of cheese which is eaten today is produced here at home."

F.A.O. WORLD SEED CAMPAIGN

The Food and Agriculture Organization of the United Nations has instituted a world campaign to promote the use of better seeds, with the aim of bringing to the attention of agricultural producers throughout the world the value of seed of improved crop varieties and of high quality as a means of increasing world food production. The Organization has designated 1961 as an International Seed Year, and during that year special campaigns with this objective in view will be conducted in member countries.

The planning and management of the campaign in the United Kingdom will be undertaken by the Seed Production Committee of the National Institute of Agricultural Botany. The Committee has now started to make its plans for the U.K. campaign and would welcome suggestions for its implementation in the United Kingdom. Correspondence should be addressed to the Seeds Division of the Ministry, who will be providing secretarial assistance, at 5–8, St. Andrew's Place, Regent's Park, London, N.W.1.

FIFTY YEARS OF FRIESIANS

The British Friesian Cattle Society celebrated its Jubilee in London on July 1st. Originating in the interest of three breeders at the Royal Show of 1909, it is claimed that the breed now supplies well over half the nation's milk and is the reservoir of more than one-third of our home-killed beef.

From the beginning the Friesian cow was recognized as a heavy milker, but it was criticized on the grounds of low butterfat and an angular conformation. The years between have been marked by the Society's foresight in the planning of simple, practical breeding policies, so that today the overall breed average for butterfat is 3·61 per cent, conformation has been improved over the early representatives of the breed beyond recognition, and the average milking potential is more than 1,000 gallons per cow, per year. The membership of the Society is today nearly 14,000.

In a special issue of the Society's Journal, Mrs. G. M. Strutt, this year's President, emphasizes that in any constructive breeding policy, type and quality must be a matter of *consistently* good line breeding, and that the female line of a bull's breeding should be given equal—if not more—consideration than the male line.

CHAROLLAIS CATTLE COMMITTEE

A committee under the chairmanship of the Rt. Hon. The Lord Terrington, K.B.E., has been appointed by the Minister of Agriculture and the Secretary of State for Scotland to consider the question of an experimental importation of Charollais cattle. The terms of reference of the Committee are: to examine the proposals that have been made for the import into Great Britain of Charollais cattle and semen, and to advise the Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland whether a prima facie case exists on animal breeding and husbandry grounds for the Ministry of Agriculture, Fisheries and Food to conduct trials with imported Charollais cattle; and if so, whether it would be inadvisable to hold such trials in view of the possible animal health or other risks attendant on any import.

Other members of the Committee are J. W. Bruford, M.R.C.V.S., Sir Alexander Glen, K.B.E., C.B., M.C., and Sir James Scott Watson, C.B.E., M.C. The Secretary of the Committee is R. A. Isaacson of the Ministry of Agriculture, Fisheries and Food.

NEW ZEALAND RABBITS

New Zealand paid dearly for more than half a century because sport lovers among the early settlers of the 1840s imported the rabbit and other game animals. Today, thanks to the Rabbit Destruction Council and rabbit boards throughout the country, New Zealand has gone a long way towards eliminating the rabbit and his hungry relations.

War against rabbits in New Zealand is now being waged on a 2,000-mile front, and the battlefield encompasses more than 33¼ million acres, and so successful have these activities been that there is now scarcely a rabbit to be seen on many hillsides which not so many years ago were a moving mass of fur.

It has been estimated that only about 5 million acres throughout New Zealand remain to be brought under control. As the battle progresses, the rabbit is becoming harder to kill. Boards everywhere are finding that the fight has become one which demands the utmost vigilance and ingenuity.

To cite one illustration of the worthwhileness of rabbit eradication, an area adjoining the Bay of Plenty had become badly eroded—the pasture had been bared to the soil—and it was nothing to see a hundred rabbits within a short radius. Before 1952 much of this country was barely carrying one sheep to the acre. Today it is carrying two-and-a-half to three, and is still improving.

PERMANENT SITE FOR THE ROYAL SHOW

The Council of the Royal Agricultural Society of England has decided to discontinue the existing arrangement whereby the Royal Show is held on a different site each year. The Society will look for a permanent site in the Midlands.

The Royal Shows of 1960 and 1961 will, as already announced, be held at Cambridge.

THE N.I.A.E. DESCRIBED

An extremely useful little book about the National Institute of Agricultural Engineering—its beginnings in the nineteen twenties and subsequent development first under the Ministry of Agriculture and more recently under the Agricultural Research Council, the important work which it is doing and its administration from Wrest Park—has been issued free by the British Society for Research in Agricultural Engineering. A page is also devoted to the Scottish Machinery Testing Station at Howden, which participates in the N.I.A.E. testing scheme, with special reference to Scottish conditions.

It can be foreseen that this booklet will be greatly in demand.

WATTLE HURDLES

There is still a demand for wattle hurdles and fencing, and hurdle makers can be found wherever hazel is grown. Our cover photograph was taken at Salhouse, near Norwich.

Sheep farmers are the main users of hurdles, but gardeners and market-gardeners like them for fences and windbreaks, and special shapes can be obtained for making small portable sheds.

A good man will make ten standard hurdles in a day. Most hurdle makers are their own masters.

Book Reviews

A History of British Livestock Husbandry, 1700–1900. R. TROW-SMITH. Routledge and Kegan Paul. 40s.

The flocks and herds of Queen Anne's England were little different from those of the Middle Ages. But the livestock on the later Victorian farm were little different from those we know today. Mr. Trow-Smith tells the story of this transformation with a learning, insight and practical understanding that secures for his history of British farm animals—of which this is the second volume—a place among the standard books on our rural past.

The cause of this drastic animal reconstruction was hope of profits from the new urban markets, the means patient trial and error and occasional flashes of inspiration on the farm. This vast and disorderly process produced an equally vast and disorderly literature which Mr. Trow-Smith has painstakingly reduced to a coherent story. In general the outline is familiar, but there are numerous modifications in detail. The achievements of the improvers are fully described, but the author's balanced appreciation of their work records loss as well as gain.

However, Mr. Trow-Smith is as interested in the management practices of the ordinary farming as in the breeding policies of the exceptional one, and he follows stock from the farm via the drove-roads to the fattening areas and the final markets. From time to time he notes such curious survivals as transhumance and the milking of ewes, and some even more curious might-have-beens of livestock history. Of these the most important was the Merino; the most improbable, the Patagonian bulls imported by Coke; and the most topical, the Charollais bull which won a prize at the Royal Show in 1856.

Although well illustrated and admirably referenced, the book is not always easy to read; the "embarrassingly abundant" material has on occasion overcrowded the text with facts and quotations, and it is not without its historical weaknesses. Loudon's massive works surely deserve mention, and the account of the coming of the rootshift is inadequate. Several pages are devoted to the turnip but no mention is made of swedes and mangolds. Yet, as the early *Correspondence of the Bath and West Society* shows, the turnip proved a very chancy crop, and it was only when the hardy swede and the fly-immune mangold joined it that the rootshift became a reliable source of winter fodder.

All who are interested in farming history, and above all those who write it, should read this book. The author sees the past with the eyes of the farmer as well as the scholar, and his footnotes quote men like Merricks as well as men like Young. Mr. Trow-Smith has written good agricultural history and, in so doing, has shown how good agricultural history should be written.

N.H.

Know your Ministry. Revised and reprinted from *The Midland Bank Review*. Europa Publications. 25s.

In the hoarding round a Westminster rebuilding site the contractor has thoughtfully provided an "inspection panel" through which the curious may enjoy the spectacle of other men at work. In the same spirit, though with a different object, the authors of this book have opened a window on those Government departments with which the business man finds himself most frequently in touch.

With this in view, the authors pick out for detailed study five departments. Those who know how multifarious are the activities of the Ministry of Agriculture, Fisheries and Food will not be surprised to meet it amongst the "big five". Indeed the multitude and variety of its activities have proved an embarrassment to the authors. A mere twenty-five pages suffice for a coherent account of the Board of Trade, leaving the reader with a clear picture of its purposes, organization and activities. On the other hand, thirty-seven pages on "the M.A.F.F." are likely to leave him bewildered by the mass of apparently unrelated functions. One's sympathies, however, are with the authors: other departments deal with industry from a single aspect; the M.A.F.F. deals with all aspects of the prototype of all industries.

Its methods are as varied as its functions. Just as the farmer has to adapt his methods to the stubbornness of nature, so apparently this Ministry has had to exercise its ingenuity in devising administrative machinery to fit the facts of farming. A deficiency payments scheme that works for wheat will not do for barley; and the marketing scheme for eggs bears little resemblance to that for hops.

In addition, the book describes in full the Treasury, the Board of Trade, the Ministry of Labour and National Service, and the Post Office, and the part each plays in the economic life of the nation. The basic services of power and atomic energy, transport and civil aviation, works and housing and scientific and industrial research are dealt with more shortly, and there are briefer notes on a variety of smaller departments.

The book includes, in the description of the two-headed Treasury, an excellent introduction to Government finance and economic control. Anyone who wishes to improve his understanding of the Government machine, as well as of the particular department with which he deals, will do well to read it.

R.V.A.

The Daffodil and Tulip Year Book, 1959. The Royal Horticultural Society. 10*s*. (11*s*. 3*d*. by post).

The 1959 Year Book follows the pattern of previous books in the series. This issue is dedicated to Mr. A. Simmonds, whose valuable work in the classification of narcissi and tulips, particularly the latter, is appreciated by many who were confused by the indiscriminate naming of new varieties.

It is good to see that the narcissus species collection at the University Botanic Gardens, Cambridge will, so far as is possible, be duplicated at Rosewarne Experimental Horticulture Station.

The many interesting details about species and culture make Mr. Findlay's account of daffodils at Windsor delightful to read. This is followed by a commonsense paper on the use of residual herbicides in tulip and narcissus growing. For those interested in hybridizing there are articles on the colouring matter in narcissus, on miniature daffodils and on breeding pink daffodils in Tasmania. Accounts are given by seven contributors of growing and showing daffodils in different parts of Australasia and North America.

I moved rather quickly through the details of the several daffodil shows and competitions in Britain. One has, I think, to be actively engaged in some aspect of exhibiting to be really interested.

The description of cultivation details in Lt.-Col. Sellon's article "Daffodils in the Cool Greenhouse" might well be taken as an example of clarity by writers of the more vague explanations of the growing of plants which we so often read.

It is refreshing to see a little more about tulips in this Year Book than in those of the two preceding years. Even so, it is still largely concerned with daffodils and more articles on tulips would make it better balanced. In spite of this minor criticism, the book will appeal to those interested in bulbs both for its wide range of subjects and for the excellence of its articles.

T.L.

Some Problems in the Breeding of Farm Livestock. T. L. BYWATER. Leeds University. 2*s*. 6*d*.

Professor Bywater's inaugural lecture, which is reprinted in this leaflet, is well worth reading by all with a keen interest in livestock breeding.

In Britain a period of remarkable progress was started by Robert Bakewell in the eighteenth century. The stock-breeders' task today is changed; now the problem is to reduce costs by adopting the best methods of breeding, feeding and management which can be devised.

The first requirement of any effective programme of improvement is that the breeder should have a rational basis for estimating the merit of his stock. Assessing by eye has led to notable progress in livestock bred primarily for meat and wool. The dairy cow, laying hen and breeding sow, however, cannot be so assessed. They require production records, and recording schemes can be regarded as one of the greatest developments in animal breeding of this century.

The relationship of environment to heredity is a much debated topic at present, while production performance of the individual may not be of sufficient value without the records of its near relatives. A significant point to the breeder is that the greatest scope for selection comes through the male. Artificial insemination increases still further this power of selec-

tion, so great emphasis must be placed on the selection of A.I. sires.

Differences of opinion arise as to whether a sire should be progeny-tested by having his daughters tested under uniform conditions at a testing station, or under farm conditions by comparison with their contemporaries. The two methods may show different performances.

Systems of breeding have not altered greatly. Can the mating of closely in-bred lines of cattle produce the same outstanding results as with hybrid maize? The application of new methods and the continued progress of livestock breeding will require the full support of breeders and breed associations alike, together with help from Government and farming organizations, if Britain is to retain her eminent position in livestock breeding.

W.L.

Economics of Producing Sugar Beet, 1957. (University of Cambridge, School of Agriculture, Farm Economics Branch Mimeographed Report No. 55.) J. S. NIX. 2*s*.

The importance of sugar beet in the Eastern Counties fully justifies this study of the economics of production. A large number of farms on different soils were surveyed in 1957, which was a bad season for sugar beet in the Eastern Counties: the heavier land suffered severely from the spring drought, while a severe attack of virus yellows reduced yields elsewhere.

The information gained confirmed most farmers' opinion that a ten-ton crop is needed to cover costs of production which, according to the survey, averaged around £62 per acre. The poor returns obtained on heavy land, where piece-work rates and harvesting costs tend to be higher, emphasize the difficulties of farming clay soil and the relatively greater benefit that the light land farmer has reaped from the development of machines and the increased use of fertilizers.

Of special interest are the data relating to the costs of harvesting and mechanization of work done in the spring. The saving from the use of a complete harvester, compared with hand work, can be £4–£5 per acre on a 25–50 acre contract. But, it is stressed, this saving is a true economy only if casual labour can be dispensed with; or the regular staff found other profitable work, for example, in the potato harvest. Equally the biggest gain from thinning by machine is where casual labour is used to single the beet, or where hoeing represents the chief labour peak of the year, so that any relief at this time enables some reduction in the permanent staff. Except in these circumstances most farmers prefer, as far as they can, to rely on hand labour and to try and make hoeing as easy and quick as possible by using improved drills and processed seed.

All growers of beet, especially in the Eastern Counties, will find it instructive to compare the detailed costings in the report with their own estimated costs of production. In addition there is much useful background information about present-day trends in the cultivation of the crop.

P.N.H.

Weather, Crops and Man. J. P. HUDSON. University of Nottingham. 2*s*.

"Our role in the universities," writes Professor Hudson, "is not so much to try to answer the technical questions of today as to define and formulate the problems of tomorrow."

He has chosen in this booklet, which reprints his inaugural lecture as Professor of Horticulture at Nottingham University, to review some of the ways in which luck —dependence on the weather—may be taken out of farming. The most important line of research which he describes is likely, in the long run, to be the breeding of plant varieties that will yield better in good years, and yet be more tolerant of bad weather in others. Another approach is the control of the plant's immediate environment. (This is practicable in glasshouses, but very difficult in the field.) The third, and most exciting, possibility is that we may be able, on a commercial scale, to alter the plant's responses to weather by using chemical stimulants.

Whichever line is followed, the task will be immense, but not impossible; Professor Hudson's enthusiasm is infectious.

A.M.R.

A Land. JACQUETTA HAWKES. Penguin Books. 3*s*. 6*d*.

The style of Mrs. Priestley's book exactly matches its evocative title. She regales us in an intensely personal manner with a logical account of the evolution of the British landscape over a period of 500 million years. Broad generalizations,

with a minimum of unfamiliar technical terms, are supplemented by happy similes, homely examples and whimsical fancies, all of which help to convey the intense enthusiasm of the writer for her subject.

After summarizing the geological contributions to the landscape, over half of the book is devoted to human modifications for good or ill of the natural scene. The story is carried through from the Stone Age to the period of industrialization (whose effects are duly castigated). If anything, the earlier periods are better covered than post-Conquest history, in which the agricultural improvers receive less than their due share of attention. The final chapter, summarizing the overall effect of these themes upon selected areas, is extremely well written.

The intelligent layman with a deep love of the countryside will find here a fascinating introduction to the study of geology, geomorphology, archaeology, economic history and historical geography. All too often the enthusiasm engendered by the study of these subjects in the field is damped by the cold abstractions and special terminology of text-books. This latest Pelican book, a re-issue of the 1951 edition, provides an appetizer for more specialized books published in this series. There are a few minor errors, but it would be churlish to enlarge upon these when so much of the book will stand up to expert scrutiny in several fields of specialized knowledge. There are sixteen plates of illustrations, but eleven of these are devoted to fossils and three to reproductions of paintings and drawings. One could have wished that the countryside had been allowed to speak for itself a little more here.

At the end of the book, to guide the newcomer to geology, there are four useful maps reconstructing the coastlines at various periods and a table of the geological systems. This volume ought to find a place on the reading lists of all farm institutes.

G.T.W.

World Wheat Statistics. International Wheat Council. 20*s*.

The 1959 edition of *World Wheat Statistics* brings the more important statistics relating to production, trade, supply, distribution and prices of wheat up to date; in some cases up to March 1959. It also includes conversion tables of weights and measures. Copies are obtainable from the Council at Haymarket House, Haymarket, London, S.W.1.

Books Received

Beef Cattle Husbandry (2nd Edition). Allan Fraser. Crosby Lockwood. 21*s*.

An Hour-Glass on the Run. A. Jobson. Michael Joseph. 18*s*.

Trade Year Book, Volume 12, 1958. F.A.O., Rome. H.M. Stationery Office, London. 17*s*. 6*d*. (19*s*. 3*d*. by post).

Report on Forest Research for the Year Ended March 1958. Forestry Commission. H.M. Stationery Office. 9*s*. 6*d*. (10*s*. 2*d*. by post).

National Milk Records, England and Wales. Report for the Year Ended September 1958. Milk Marketing Board. 7*s*. 6*d*.

The Hannah Dairy Research Institute Report for the Three Years Ended 31st March 1959. (Obtainable free from the Secretary, Kirkhill, Ayr.)

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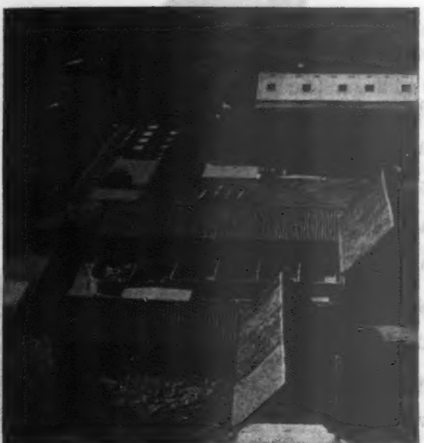

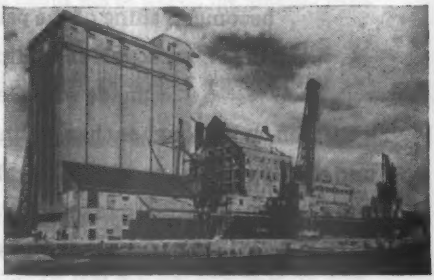

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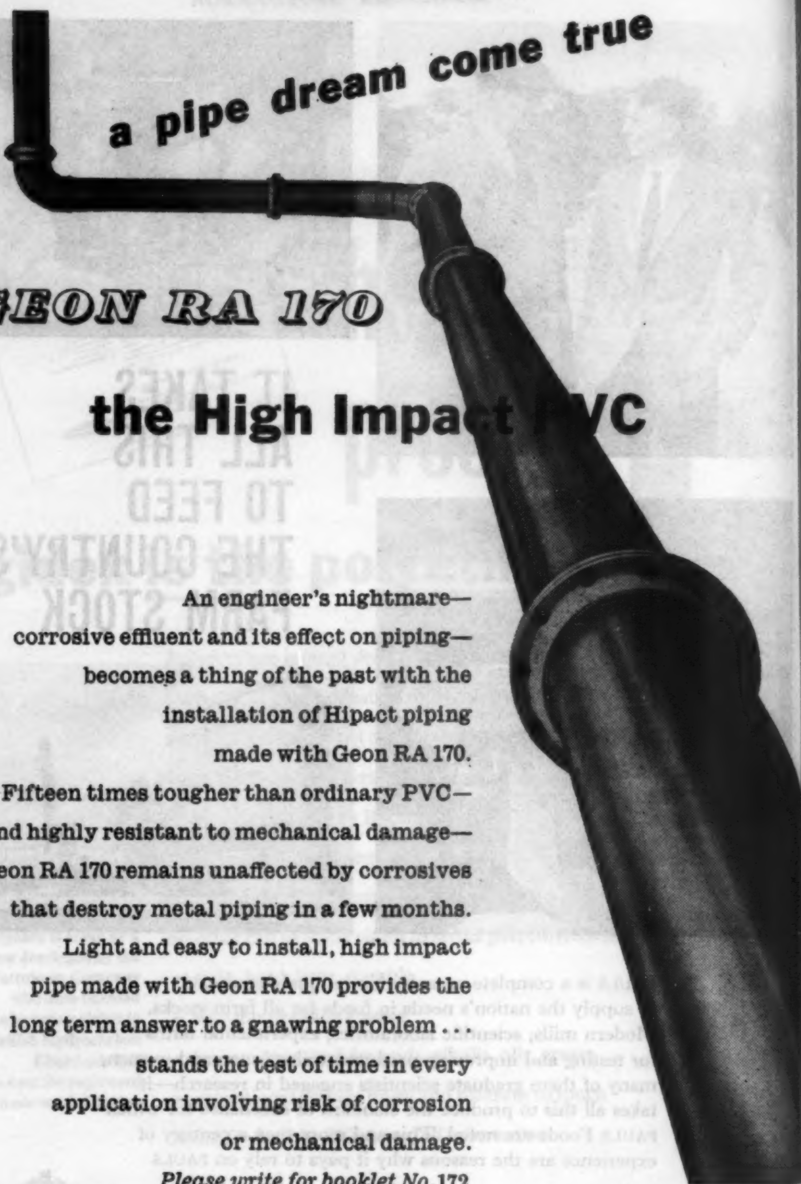

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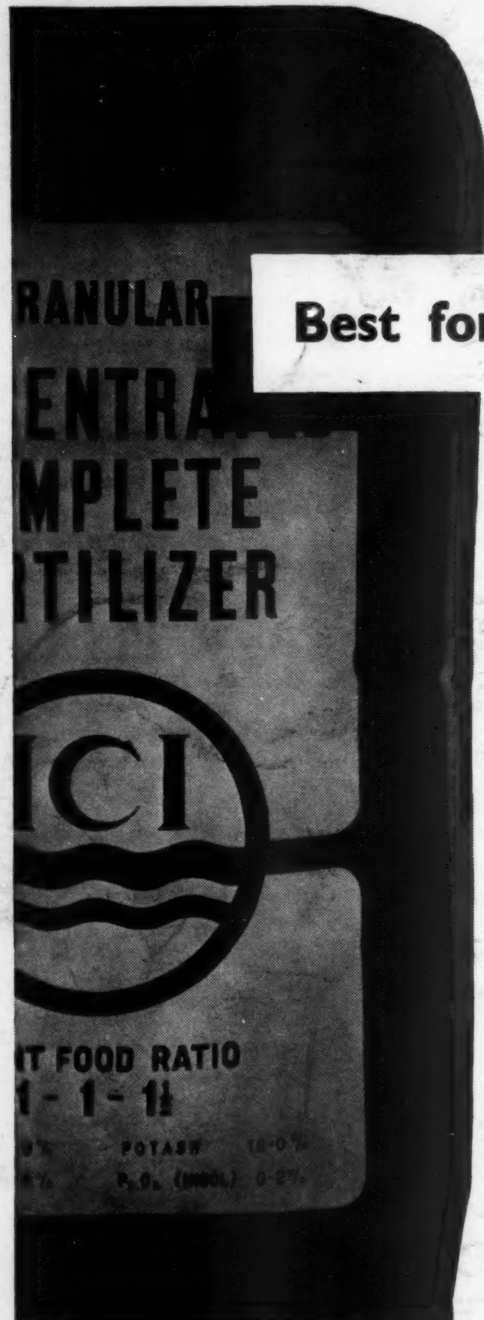
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